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ADSS

History of Science  
Society

IFTH  
INTERNATIONAL  
CONGRESS

ON THE HISTORY OF  
OCEANOGRAPHY



26 May 1994

ICHO V

University of California, San Diego  
Office of the Conference Manager  
Mail code 0513  
9500 Gilman Drive  
La Jolla, CA 92093-0513  
USA  
Telephone: (619) 534-4220  
FAX: 619 534-2042

Robert J. Silverman  
Department of the Navy  
Office of Naval Research  
Seattle Regional Office  
1107 NE 45th Street, Suite 350  
Seattle, WA 98105-4631

Dear Mr. Silverman:

After the final financial reports for the Fifth International Congress on the History of Oceanography have been prepared, we are able to declare the congress a complete success! Over one-hundred fifty historians and oceanographers gathered on the bluffs of La Jolla from 7-14 July 1993 to discuss their common interests in the history of oceanography. There were one hundred six papers delivered during the week by scholars coming to Scripps Institution of Oceanography from all over the world (Romania, China, Tanzania, Israel, Mexico, United Kingdom, France, Japan, Russia, Ukraine, Belgium, Poland, Sweden, Monaco, Italy, Denmark, Australia, Canada, Germany, Portugal, Egypt, and the United States). Please consult the enclosed "Final Program and Abstracts" for more detailed information.

Funds from the Office of Naval Research proved to be invaluable for the success of the congress. We were able to provide travel grants for twenty-four scholars, registration waivers for thirty-three participants, and housing subsidies for ten attendees. In addition, the congress sponsored four major receptions and one dinner for all the participants, thus providing a social ambience that helped to maximize informal exchanges among those attending the congress. Finally, the funds we have raised will enable us to publish a proceedings from the congress. At the present time, Professor Philip F. Rehbock and I are editing the papers to prepare the volume for publication, which will be in print sometime in late 1994 or early 1995. The entire budget for ICHO-V (see enclosed "ICHO-V BUDGET") included income of \$44,733.35 and expenses of \$44,598.17. The fund balance (\$135.18) and the \$2,000 reserve (from UNESCO funds) will be used for publication costs associated with the preparation of the proceedings volume.

In specific terms, Office of Naval Research funds were used to bring twelve scholars from the United States (including Hawaii) and Canada to the congress (\$7,950), to defray the expenses of one social event (\$1,000), and to meet general expenses associated with organizing the congress (\$1,150).

Program Co-Chairs

Dr. Keith R. Benson  
Department of Medical History and Ethics, SB-20  
University of Washington  
Seattle, WA 98195 USA  
email: krbenson@u.washington.edu  
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Dr. Philip F. Rehbock  
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DTIC

ONR Seattle  
MAY 31 1994

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Office of the Conference Manager  
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9500 Gilman Drive  
La Jolla, CA 92093-0513  
USA  
Telephone: (619) 534-4220  
FAX: 619 534-2042

While planning, organizing, and managing the congress was a tremendous amount of work, the end result of ICHO-V was deeply satisfying. The participants were tremendously enthusiastic about the congress, both during their week in La Jolla and in written communication after the congress. Perhaps most important, the quality of the presentations and the papers was superb. The intellectual exchanges at ICHO-V matched or exceeded that of any of the previous congresses; indeed, it continued the impressive tradition of successful congresses begun at Monaco in 1966.

I would like to express our sincere and heartfelt thanks to you and to the Office of Naval Research for your kind and generous patronage. Without your support and encouragement, ICHO-V would not have been possible. I will provide you with a copy of the final proceedings from the congress when it appears in print.

Program Co-Chairs

Dr. Keith R. Benson  
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FAX: 808 956-9600  
Telephone: (808) 956-6850

Please let me know if I may provide additional information for you. For my colleagues, Professor Philip F. Rehbock and Deborah Day, I remain,

Sincerely yours,

*Keith R. Benson*

Keith R. Benson

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DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
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## ICHO-V BUDGET

### Income

UNESCO/IOC	8,000.00	[+2,000.00 reserve]
ONR	10,000.00	
UW Oceanography	2,500.00	
SCOR	8,000.00	
ISF	2,520.00	
SeaGrant Washington	1,500.00	
SeaGrant Hawaii	2,500.00	
Scripps	6,213.35	
Donations (anon.)	3,500.00	
<b>TOTAL</b>	<b>44,733.35</b>	<b>[+2,000.00 reserve]</b>

### Expenses

Travel Grants	20,491.00	
Reg. Waivers	5,050.00	
Housing	3,650.56	
General Expense	2,879.86	
Publication Reserve	2,500.00	[+2,000 reserve]
Social Events	8,194.75	
Publicity	1,832.00	
<b>TOTAL</b>	<b>44,598.17</b>	<b>[+2,000 reserve]</b>
<b>FUND BALANCE</b>	<b>135.18</b>	

Note: The \$2,000.00 reserve amount is the money held by UNESCO/IOC pending the submission of ICHO-V final report. The sum will then be transferred to ICHO-V account. This money will be used for publication costs, in addition to the \$2,500 reserve we have allotted for publication.

## ICHO-V OFFICE OF NAVAL RESEARCH

### Income

General account	\$10,000.00
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### Expense

Travel grants* (12 awards)	7,950.00
Social event	1,000.00
General expenses	1,150.00
Balance	0.00

\*Travel awards were for partial reimbursement only. Recipients required to obtain matchin funds.

*F*INAL  
PROGRAM  
AND  
ABSTRACTS



FOR THE  
FIFTH INTERNATIONAL  
CONGRESS ON  
THE HISTORY  
OF OCEANOGRAPHY

JULY 7-14, 1993

*Scripps Institution of Oceanography*

La Jolla, California  
United States of America

## **SUPPORTING ORGANIZATIONS**

### **ASSOCIATION FOR ASIAN STUDIES**

- IABO - International Association for Biological Oceanography
- IAPSO - International Association for the Physical Sciences of the Sea
- IUHPS - International Union of the History and Philosophy of Science - Commission on Oceanography
- IUHPS-DHS - International Union of the History and Philosophy of Science - Division of History of Science
- SCOR - Scientific Committee on Oceanic Research

### **PACIFIC CIRCLE**

- PICES - North Pacific Marine Science Organization

### **INTERNATIONAL PATRONAGE**

J.R. Beyster  
California Sea Grant College  
MITRE Corporation  
Office of Naval Research  
United Nations Educational, Scientific and Cultural Organization  
University of California, San Diego. Scripps Institution of Oceanography  
University of Hawaii at Manoa:  
College of Natural Sciences  
College of Arts & Humanities  
School of Ocean & Earth Science & Technology  
Office of Research Relations  
University of Hawaii Sea Grant College Program  
University of Washington, SeaGrant Program  
University of Washington, School of Oceanography  
and two members of the Scripps Faculty

### **HOSPITALITY**

The Martin Johnson House (T-29) at the Scripps Institution of Oceanography has been reserved as a hospitality room for the Congress. Congress participants can meet, talk, and have coffee there during weekday Congress sessions.

**FIFTH INTERNATIONAL CONGRESS ON  
THE HISTORY OF OCEANOGRAPHY**

**JULY 7 - 14, 1993**

Honorary President: Jean Théodoridès, CNRS, Paris

Program Co-Chairmen: Philip F. Rehbock, University of  
Hawaii  
Keith Benson, University of  
Washington

Local Arrangements: Deborah Day, Scripps Institution of  
Oceanography, UCSD

**TUESDAY, JULY 6**

**ARRIVAL AND REGISTRATION**  
Muir Campus, UCSD

**WEDNESDAY, July 7**

8am - 10am

**REGISTRATION**  
Scripps Institution of Oceanography.

10am - Noon

**OPENING CEREMONY**  
Sumner Auditorium, Scripps  
Institution of Oceanography

**Call To Order by Program Co-Chairs**  
Fritz Rehbock  
Keith Benson

**Welcoming Remarks**  
From President Jean Théodoridès,  
delivered by Jacqueline Carpine-Lancre,  
France

By SIO Director, Edward Frieman

By Local Arrangements, Deborah Day

**Keynote Address**  
by Robert Marc Friedman

"Contexts for Constructing an Ocean  
Science: The Career of Harald Ulrik  
Sverdrup (1888-1957)"

**WEDNESDAY, JULY 7 - continued**

**2**

**2pm - 5:30pm**

**PLENARY 1**

**OCEANOGRAPHY AROUND THE PACIFIC RIM**

Chair: Joseph Reid, USA  
Sumner Auditorium, Scripps  
Institution of Oceanography

**"HISTORICAL ACCOUNT OF OCEANOGRAPHY IN CHILE"**

Nibaldo Bahamonde & Tarsicio Antezana,  
Chile

**"HALF A CENTURY OF ORSTOM OCEANOLOGY IN THE SOUTH PACIFIC"**

Francis Rougerie, Tahiti, et. al.

**"AUSTRALIAN BOUNDARY CURRENTS-AN HISTORIC HANDICAP AND A MODERN SCIENTIFIC CHALLENGE"**

Angus McEwan & E. Wood, Tasmania

**"HISTORY OF OCEANOGRAPHIC STUDIES IN CHINA"**

Wu Baoling, China

**"RUSSIAN OCEANOGRAPHIC INVESTIGATIONS OF THE PACIFIC: HISTORY AND SOME RESULTS"**

Arkady Alekseev & Igor Rostov, Russia

**"HISTORY OF FISHERIES SCIENCE"**

Yoshiaki Matsuda, Japan

**"THE HISTORY OF OCEANOGRAPHY ALONG THE MEXICAN AND PACIFIC COAST"**

Richard A. Schwartzlose, USA & Saúl Alvarez-Borrego, Mexico

**THURSDAY, JULY 8**

**8 - 10am**

**REGISTRATION**

Scripps Institution of Oceanography



**9 - 11:30am**

**PLENARY 2:**

**ARCHIVAL RESOURCES FOR THE HISTORY OF OCEANOGRAPHY**

Chair: Jacqueline Carpine-Lancre, Monaco  
Sumner Auditorium, Scripps Institution  
of Oceanography

**"THE STAZIONE ZOOLOGICA: A CLEARING HOUSE  
FOR KNOWLEDGE OF MARINE ORGANISMS"**

Christiane Groeben, Italy

**"RESOURCES FOR THE STUDY OF OCEANOGRAPHY  
AT THE ARCHIVES OF SCRIPPS INSTITUTION  
OF OCEANOGRAPHY"**

Deborah Day, USA

**"SOURCES FOR THE HISTORY OF OCEANOGRAPHY  
AT THE CALIFORNIA ACADEMY OF SCIENCES AND  
IN THE PACIFIC NORTHWEST"**

Pennington P. Ahlstrand & Thomas D.  
Moritz, USA

**"SOURCES FOR THE HISTORY OF OCEANOGRAPHY  
AT THE SMITHSONIAN INSTITUTION AND THE  
NATIONAL ARCHIVES"**

Pamela M. Henson, USA

**"UNIVERSITY OF WASHINGTON OCEANOGRAPHY:  
HISTORY IN THE ARCHIVES"**

James W. Markham, USA

**1:30 - 3:15pm**

**CONCURRENT 1A:**

**OCEANOGRAPHIC BOOKS AND BIBLIOGRAPHY**

Chair: Pennington P. Ahlstrand, USA  
Marine Biology Conference Room

**"ABOUT THE OLDEST OCEANOGRAPHY TEXTBOOK:  
THE 350TH ANNIVERSARY OF HYDROGRAPHIE...  
BY GEORGE FOURNIER, PUBLICATION IN PARIS"**

Zdzislaw Milulski, Poland

**"BIBLIOGRAPHY OF NORTH-WESTERN PACIFIC  
OCEANOGRAPHY"**

Alexander V. Tregubov, Russia

**1:30 - 3:15pm**

**CONCURRENT 1B:**

**OCEAN TECHNOLOGY**

Chair: Robert Marc Friedman, USA  
Sumner Auditorium, Scripps  
Institution of Oceanography

**"THE DEVELOPMENT OF RESEARCH VESSEL  
DESIGN"**

George G. Shor, USA

**"SWEDISH OCEANOGRAPHIC INSTRUMENTS UP TO  
1950"**

Artur Svansson, Sweden

**"SUBMERSIBLES IN OCEANOGRAPHIC RESEARCH:  
SIX DECADES OF DISCOVERY"**

Bruce H. Robinson, USA

**"THE SAGA OF TIDE MILLS"**

Roger H. Charlier & Loïc Menanteau,  
Belgium

**3:45 - 5:30pm**

**CONCURRENT 2A:**

**EDUCATIONAL MISSION OF MARINE STUDIES**

Chair, James Sullivan, USA  
Sumner Auditorium, Scripps  
Institution of Oceanography

**"EDUCATIONAL MISSION OF MARINE SCIENCE:  
CASE STUDY OF EAST AFRICA"**

Selim Morcos, Egypt

**"SCHOOL AND POPULAR MARINE SCIENCE  
EDUCATION IN THE UNITED KINGDOM"**

Malcolm Walker, UK

**"EARLY AMERICAN ADVENTURERS IN MARINE  
SCIENCE EDUCATION"**

Keith Benson, USA

**THURSDAY, JULY 8 - continued**

5

3:45 - 5:30pm

**CONCURRENT 2B:**

**OCEANOGRAPHY IN SOUTH ASIA**

Chair: Andrew Dickson, USA

Marine Biology Conference Room

**"THE INDO-PACIFIC IMPRINTS UPON  
OCEANOGRAPHIC HISTORY"**

Kothandaraman Krishnamurthy, India

**"DEVELOPMENT OF OCEANOGRAPHY IN PAKISTAN"**

N. M. Tirmizi, Pakistan

**"SOCIO-ECONOMIC IMPACT OF THE SEAS AROUND  
INDIA: A HISTORICAL REVIEW"**

P.S. Srivastava, India

5:30 - 7:30pm

**EVENING RECEPTION AND LECTURE:**

Sumner Auditorium, Scripps

Institution of Oceanography

**"CHALLENGES AND OPPORTUNITIES IN NAVAL  
OCEANOGRAPHY IN THE POST-COLD WAR WORLD"**

Dr. Tim Coffey, USA

Director of Research, Naval Research  
Laboratory

**FRIDAY, JULY 9**

8 - 10am

**REGISTRATION**

Scripps Institution of Oceanography

**9 - 11:30am**

**PLENARY 3:**

**PACIFIC WATERS IN MOTION**

**Chair: Kern Kenyon, USA  
Sumner Auditorium, Scripps  
Institution of Oceanography**

**"DUPERREY'S 1831 CHART OF OCEANIC CURRENTS  
IN THE PACIFIC AND THE FIRST REPORTS OF  
THE EQUATORIAL COUNTER-CURRENT DURING THE  
FIRST HALF OF THE 19TH CENTURY"**

**Philippe Hisard, France**

**"THE WESTERN BOUNDARY CURRENTS OF THE  
PACIFIC: THE DEVELOPMENT OF OUR  
OCEANOGRAPHIC KNOWLEDGE"**

**Joyce E. Jones & Ian S.F. Jones, Australia**

**"PACIFIC WATERS AND THE POG: THE ORIGIN OF  
PHYSICAL OCEANOGRAPHY ON THE WEST COAST  
OF CANADA"**

**Eric L. Mills, Canada**

**"THE NINETEENTH-CENTURY CHARTING OF  
CURRENTS IN THE PACIFIC OCEAN"**

**Ray G. Peterson, USA**

**"THE NORPAC EXPEDITION OF 1955"**

**Joseph L. Reid, USA**

**"REFLECTIONS ON MY RESEARCH IN THE INDO-  
PACIFIC, 1954-1992"**

**Klaus Wyrtki, USA**

**1:30 - 3:15pm**

**CONCURRENT 3A:**

**EXPEDITIONS AND EXPLORATION**  
Chair: Nathan Reingold, USA  
Sumner Auditorium, Scripps  
Institution of Oceanography

**"THE OCEANOGRAPHIC WORK OF THE DISCOVERY,  
1901-1931"**

Ann Savours Shirley, UK

**MEMORIAL RESEARCH VESSEL VITJAZ:  
CONTRIBUTION IN OCEANOGRAPHY, 1949-1979**  
Svetlana S. Sivkova, Russia

**"MOHOLE TO THE DEEP SEA DRILLING PROGRAM"**  
William Nierenberg, USA

**"SONAR INVESTIGATIONS OF THE GEOLOGY OF  
THE OCEAN FLOOR OFF THE HAWAIIAN ISLANDS"**  
John B. Wilson & W. R. Normark, UK

**1:30 - 3:15pm**

**CONCURRENT 3B:**

**LEADERS OF OCEAN RESEARCH**  
James W. Markham, USA  
Marine Biology Conference Room

**"ANDREAS SPARRMAN, 1748-1820,"**  
David Dyrssen, Sweden

**"SECCHI AND HIS DISK"**  
Henry Charnock, UK

**"PRINCE ALBERT OF MONACO and KING CARLOS  
OF PORTUGAL: THEIR CONTRIBUTION TO THE  
KNOWLEDGE OF THE ATLANTIC DEEP-SEA FAUNA"**  
Luiz Saldanha, Portugal

**"GEORGE WALLACE MELVILLE: HIS INFLUENCE IN  
POLAR EXPLORATION AND IN SHIP DESIGN"**  
A. Aristides Yayanos, USA

**3:45 - 5:30pm**

**CONCURRENT 4A:**

**EXPEDITIONS AND EXPLORATION: THE PACIFIC**

Chair: Bruce Hevly, USA  
Sumner Auditorium, Scripps  
Institution of Oceanography

**"ALLAN HANCOCK PACIFIC EXPEDITIONS AND  
CONTRIBUTIONS TO MARINE BIOLOGY"**

Anwar Abdel Aleem, Egypt

**"SAMUEL STILLMAN BERRY AND THE R/V  
ALBATROSS"**

Larry T. Spencer, USA

**"WILLIAM STIMPSON AND PACIFIC EXPLORATION,  
1854-1856"**

Ronald S. Vasile, USA

**"MAJOR RESULTS OF THE INVESTIGATIONS OF  
THE DANISH DANA EXPEDITION (1928-1930) IN  
THE INDO-PACIFIC"**

Torben Wolff, Denmark

**3:45 - 5:30pm**

**CONCURRENT 4B:**

**OCEANOGRAPHY AND ITS PUBLICS**

Chair: Eric Mills, Canada  
Marine Biology Conference Room

**"WHALING AND THE AMERICAN COLONIES"**

Dale E. Ingmanson & William J. Wallace,  
USA

**"SEA MONSTERS: MYTH OR GENUINE RELIC OF  
THE PAST?"**

Sherrie L. Lyons, USA

**"WILLIAM SAVILLE KENT, AQUARIA, AND THE  
PACIFIC: PROBLEMS OF PROFESSIONALIZATION  
IN MARINE SCIENCE IN THE LATE 19TH  
CENTURY"**

Margaret Deacon, UK

**MONDAY, JULY 12**

**9**

**8 - 10am**

**REGISTRATION**

Scripps Institution of Oceanography

**9 - 11:50am**

**PLENARY 4:**

**BEYOND DARWIN: CORAL REEF RESEARCH IN THE TWENTIETH CENTURY**

Chair: Daphne Gail Fautin, USA  
Sumner Auditorium, Scripps  
Institution of Oceanography

**"A NEW KIND OF EXPEDITION: STANLEY GARDINER AND MAURICE YONGE IN CORAL REEF STUDIES - AND THEIR SUCCESSORS"**

David R. Stoddart, USA

**"PRE-WAR RESEARCH IN BIOLOGY OF REEF CORALS IN JAPAN, ESPECIALLY IN PALAU AND FORMOSA,"**

Siro Kawaguti, Japan

**"OPERATION CROSSROADS AND THE DRILLING AT BIKINI AND ENEWETAK"**

Joshua I. Tracey, Jr., USA

**"THE BIOLOGY OF CORAL REEFS FROM 1969 - RENAISSANCE OR REVOLUTION?"**

Patricia Kott Mather, Australia

**"CARIBBEAN CONTRIBUTIONS TO REEF RESEARCH, BIG FISH - SMALL POND?"**

Robert A. Kinzie III, USA

**"CORAL REEFS, SCIENCE AND POLITICS: LINKS AND CRITERIA FOR DECISIONS SINCE TWO CENTURIES: A FRENCH CASE HISTORY"**

Bernard Salvat, France

1:30 - 3:15

CONCURRENT 5A:

**HISTORY OF FISHERIES MANAGEMENT**

Chair: Warren Wooster, USA  
Sumner Auditorium, Scripps  
Institution of Oceanography

**"ONE HUNDRED YEARS OF THE SERGESTID SHRIMP  
INDUSTRY IN SURUGA BAY - DEVELOPMENT OF  
JURISDICTION AND SOCIAL POLICY"**

Makoto Omori, Japan

**"SCIENTIFIC MANAGEMENT, OCCUPATION POLICY,  
AND THE POSTWAR REVIVAL OF JAPANESE  
FISHERIES, 1945-1953"**

Harry N. Scheiber, USA

**"WILLIAM C. HERNGTON AND THE EVOLUTION  
OF OCEAN MANAGEMENT"**

Amy Toro, USA

1:30 - 3:15PM

CONCURRENT 5B:

**EUROPE IN THE PACIFIC**

Chair: Christiane Groeben, Italy  
Marine Biology Conference Room

**"ITALIAN CONTRIBUTIONS TO THE KNOWLEDGE OF  
THE SOUTHEAST PACIFIC OCEAN"**

Noberto Della Croce, Italy

**"GERMANIA IN PACIFICO: EARLY GERMAN  
CONTRIBUTIONS TO PACIFIC RESEARCH, 1741-  
1876"**

Gerhard Kortum, Germany

**"THE APPROACH OF ALFRED MERZ (1880-1925),  
GEORG WÜST (1890-1977), AND ALBERT DEFANT  
(1884-1974) TO PACIFIC OCEANOGRAPHY"**

Walter Lenz, Germany

**"INVESTIGATIONS OF THE HUMBOLDT CURRENT  
FOLLOWING A LONG SERIES OF MISADVENTURES:  
THE VOYAGE OF THE R.R.S. SCORESBY, MAY-  
AUGUST 1931"**

Rosalind R.G. Marsden, UK



3:45 - 5:30pm

CONCURRENT 6A:

HISTORY OF FISHERIES AND MARINE PRODUCTS  
Chair: Harry Scheiber, USA  
Sumner Auditorium, Scripps  
Institution of Oceanography

"THE EVOLUTION OF IDEAS OF THE MECHANISMS  
OF AMPHIHALINE TELEOST M. PIONS"  
Maurice Fontaine, France

"THE USES AND ABUSES OF SCIENTIFIC  
EXPERTISE IN THE ENGLISH INSHORE FISHING  
INDUSTRY, 1860-1900"  
Gill Parsons, UK

"HUXLEY'S RED HERRING: T.H. HUXLEY AND  
EARLY 20TH CENTURY FISHERIES BIOLOGY"  
Jennifer M. Hubbard, Canada

"OCEAN FOOD AND ENERGY FROM CALIFORNIA  
MARICULTURE: AN EVALUATION OF THE U.S.  
MARINE BIOMASS PROJECT FROM 1972 TO 1986"  
Peter Neushul & Lawrence Badash, USA

3:45 - 5:30pm

CONCURRENT 6B:

OCEANOGRAPHY: THE AMERICAN CONTEXT  
Chair: Duncan Agnew, USA  
Marine Biology Hall Conference Room

"SELLING BELLEVUE: THE EMERGENCE OF NAVAL  
OCEANOGRAPHY IN THE UNITED STATES, 1914-  
1924"  
Gary E. Weir, USA

MARINE BIOLOGY OR OCEANOGRAPHY: EARLY  
DEVELOPMENTS IN MARINE SCIENCE ON NORTH  
AMERICA'S WEST COAST"  
Keith Benson

"MARINE BIOLOGY/BIOLOGICAL OCEANOGRAPHY  
AND THE FEDERAL PATRON: THE NSF INITIATIVE  
IN BIOLOGICAL OCEANOGRAPHY IN THE 1960s"  
Toby A. Appel, USA

"THE ROLE OF SPECTRAL REPRESENTATIONS IN  
OCEAN WAVE PHYSICS"  
David Irvine

5:30 - 7:30pm

**EVENING RECEPTION AND LECTURE**

Sumner Auditorium, Scripps  
Institution of Oceanography

**"OCEANOGRAPHY: THE NEXT FIFTY YEARS"**

Dr. John A. Knauss, USA  
Former Administrator, National Oceanic and  
Atmospheric Administration

**TUESDAY, JULY 13**

8 - 10am

**REGISTRATION**

Scripps Institution of Oceanography

8:30-11:45am

**PLENARY 5:**

**CONTINENTS VS. OCEANS IN THE EARTH  
SCIENCES REVOLUTION**

Chair: Robert Parker, USA  
Sumner Auditorium, Scripps  
Institution of Oceanography

**"GRAVITY SURVEYS IN THE 'PERMANENT' OCEAN  
BASIN: AN INSTRUMENTAL CHINK IN A  
THEORETICAL SUIT OF ARMOR"**

Naomi Oreskes, USA

**"EVOLUTION OF THE TECTOGENE CONCEPT, 1930-  
1965"**

Alan O. Allwardt, USA

**"THE PLATE TECTONICS REVOLUTION: THE SAN  
ANDREAS BRIDGE BETWEEN OCEANIC AND  
CONTINENTAL TECTONICS"**

Tanya Atwater, USA

**"THE HISTORY OF THE TERRANE CONCEPT:  
CONTINENTAL GEOLOGISTS STRIKE BACK"**

Homer E. LeGrand, USA

**1:30 - 3:15pm**

**CONCURRENT 7A:**

**CHEMISTRY OF THE OCEANS**

Chair: Karl Hufbauer, USA  
Sumner Auditorium, Scripps  
Institution of Oceanography

**"THE DEVELOPMENT OF OUR UNDERSTANDING OF  
THE CARBON DIOXIDE SYSTEM IN SEA WATER"**  
Andrew G. Dickson, USA

**"EARLY ATTEMPTS AT DETERMINATION OF THE  
SALINITY OF SEAWATER FROM MEASUREMENTS OF  
ITS ELECTRIC CONDUCTIVITY"**  
Jens Smed, Denmark

**"THE HISTORY OF CHEMICAL DETERMINATIONS OF  
SALINITY"**  
William J. Wallace, USA

**"THE HISTORY OF CHEMICAL OCEANOGRAPHY IN  
AUSTRALASIAN WATERS"**  
Andrew McTaggart, Australia

**1:30 - 3:15pm**

**CONCURRENT 7B:**

**NATIONAL CONTRIBUTIONS TO OCEANOGRAPHIC  
HISTORY: EASTERN EUROPE**  
Chair: Walter Lenz, Germany  
Marine Biology Conference Room

**"THE PIONEERS OF OCEANOGRAPHIC RESEARCH IN  
ROMANIA"**  
Gheorghe Serpoianu, Romania

**"ROMANIAN DEVELOPMENTAL CONTRIBUTIONS  
FROM E. RACOVITZA AND G. ANTIPA TO  
SCIENTIFIC EXPLORATION OF THE  
MEDITERRANEAN SEA"**  
Alexandru Bologa & Alexandru Marinescu,  
Romania

**"FOUR CENTURIES OF PHYSICAL OCEANOGRAPHY  
IN CROATIA"**  
Mirko Orlic, Croatia

**3:45 - 5:30pm**

**CONCURRENT 8A:**

**PACIFIC MARINE BIOGEOGRAPHY IN HISTORICAL PERSPECTIVE**

Chair: E. Alison Kay, USA  
Sumner Auditorium, Scripps  
Institution of Oceanography

**"OCEAN CURRENT PATTERNS AND DISPERSAL OF CORAL REEF FAUNA: CHANGING HISTORICAL PERSPECTIVES"**

Paul L. Jokiel, USA

**"DEVELOPMENT OF OCEANOGRAPHY IN THE E.T.P. AND THE UNDERSTANDING OF BIOGEOGRAPHIC ISOLATION AND EVOLUTION IN THE GALAPAGOS ISLANDS"**

Guy T. Houvenaghel, Belgium

**"JAMES DWIGHT DANA'S PRINCIPLE OF CEPHALIZATION"**

Janet Bell Garber, USA

**"H.B. GUPPY: A REEF FISH OUT OF WATER IN THE LATE 19TH CENTURY"**

David R. Stoddart, USA

**3:45 - 5:30pm**

**CONCURRENT 8B:**

**NATIONAL CONTRIBUTIONS TO OCEANOGRAPHIC HISTORY: WHITE SEA TO BLACK SEA**

Chair: Keith Benson, USA  
Marine Biology Conference Room

**"UNDERWATER LANDSCAPE MAPPING OF THE SEASHORES"**

Alex Petrov, Ukraine

**"WHITE SEA OCEANOGRAPHY AND THE ROLE OF THE CLOISTERS IN MARINE STUDIES AND FISHERIES"**

Helen P. Makarenkova, Russia

**"SOME HISTORICAL ASPECTS OF DEVELOPMENT OF THE RESEARCHES IN THE INSTITUTE OF BIOLOGY OF THE SOUTHERN SEAS MADE BY A. KOVELEVSKY (IBSS)"**

M. Sergei Ignatjev & Alex N. Petrov, Ukraine

**WEDNESDAY, JULY 14**

15

9:00-11:30am

**PLENARY 6:**

**SCRIPPS AT NINETY**

Chairs: Elizabeth N. Shor/George G. Shor,  
USA

Sumner Auditorium, Scripps  
Institution of Oceanography

**"SCRIPPS BENEFACTIONS: THE ROLE OF THE  
SCRIPPS FAMILY IN THE FOUNDING OF THE  
SCRIPPS INSTITUTION OF OCEANOGRAPHY"**

Deborah Day, USA

**"C.A. KOFOID'S ROLE IN THE ORIGIN OF  
SCRIPPS INSTITUTION OF OCEANOGRAPHY"**

Fred N. Spiess, USA

**"RECOLLECTIONS OF PEOPLE AND ACTIVITIES  
AT SCRIPPS DURING THE 1930s"**

Eugene C. LaFond & Katherine G. LaFond,  
USA

**"THE SVERDRUP YEARS"**

Walter H. Munk, USA

**"THE INNOCENTS ABROAD EARLY: SCRIPPS  
INSTITUTION OF OCEANOGRAPHY'S 1950's  
EXPLORATION OF THE PACIFIC"**

Robert L. Fisher, USA

1:30 - 3:15pm

CONCURRENT 9A:

OCEANOGRAPHY IN ANTARCTIC WATERS

Chair: Margaret Deacon, UK  
Sumner Auditorium, Scripps  
Institution of Oceanography

"OCEANOGRAPHIC RESEARCH OF THE FIRST  
RUSSIAN ANTARCTIC EXPEDITION, 1819-1821"  
Alexander S. Studenetsky, Russia

"SOME ASPECTS OF EARLY 20TH CENTURY  
OCEANOGRAPHY: THE FIRST GERMAN ANTARCTIC  
EXPEDITION"  
Maurice M. Raraty, UK

"EARLY EXPLORATORY VOYAGES AND ANTARCTIC  
EXPEDITIONS: THE LOCAL PERSPECTIVE"  
Ramiro P. Sánchez & V. Angelescu,  
Argentina

1:30 - 3:15pm

CONCURRENT 9B:

**ANCIENT AND NATIVE OCEAN TRADITIONS**

Chair: Donald J. McGraw, USA  
Marine Biology Conference Room

**"NATIVE CAROLINE ISLANDS KNOWLEDGE OF  
MARINE ANIMALS AND THE OCEAN"**

Alan E. Davis, Chuuk

**"AN ACCOUNT OF TRADITIONAL OCEANOGRAPHIC  
KNOWLEDGE PREVAILING AMONG TRIBES OF  
ANDAMAN AND NICOBAR ISLANDS"**

G.A. Thivakaran & G. Victor Rajamanickam,  
India

**"FROM SATIN TO SHAMU: THE UNMAKING AND  
MAKING OF THE KILLER WHALE"**

Brian Mackness, Australia

**"BRIEF HISTORY OF MARINE DEVELOPMENT IN  
ANCIENT CHINA"**

Xu Qiwang, China

**"VOYAGES OF ADMIRAL ZHENG HE BEFORE  
COLUMBUS"**

Ye Longfei, China

**3:45 - 5:30pm**

**CONCURRENT 10A:**

**ECOLOGY: LITTORAL AND ABYSS**

**Chair: Fritz Rehbock, USA  
Sumner Auditorium, Scripps  
Institution of Oceanography**

**"THE RISE AND FALL OF THE COMMUNITY  
PARADIGM"**

**Joel W. Hedgpeth, USA**

**"ON THE NATURE OF FINAL PROOF IN BIOLOGY:  
HADAL BACTERIA AND THE 'AZOIC ZONE'"**

**Donald J. McGraw, USA**

**"DEEP-SEA PLANKTON EXPLORATION IN  
HISTORICAL PERSPECTIVE"**

**Baruch Kimor, Israel**

**"MOLECULAR BIOTECHNOLOGY AND OCEANOGRAPHY:  
DIAMONDS IN THE ROUGH"**

**George I. Matsumoto, USA**

**3:45 - 5:30pm**

**CONCURRENT 10B:**

**OCEANOGRAPHY SOUTH OF THE SAHARA**

**Chair: Anwar Abdel Aleem, Egypt  
Marine Biology Conference Room**

**"TRENDS IN OCEAN-CLIMATE SERVICES IN WEST  
AND CENTRAL AFRICA"**

**O. Ojo, Nigeria**

**"OCEANOGRAPHIC EXPEDITION RECORDS OF THE  
WEST INDIAN OCEAN UP TO 1965"**

**Norbert A. Kayombo, Tanzania**

**CLOSING CEREMONY**



**FIFTH INTERNATIONAL CONGRESS  
ON  
THE HISTORY OF OCEANOGRAPHY**

**ABSTRACTS**

**Keynote Address**

**CONTEXTS FOR CONSTRUCTING AND OCEAN SCIENCE:  
THE CAREER OF HARALD ULRIK SVERDRUP (1888-1957)**

Robert Marc Friedman  
University of California  
San Diego  
University of Oslo

Harald Ulrik Sverdrup's career sheds light on the emergence of oceanography as a science and professional discipline. Sverdrup's ability to define oceanographic research problems and carve a professional niche for himself was shaped by larger forces in society. Oceanography, of course, entailed 'Big Science' even during the decades prior to World War II. Changing political, economic, and cultural circumstances provided opportunities and constraints for Sverdrup to pursue and help define an ocean science. Neither the present contours of the science nor its relations with society are inevitable or 'natural.' Sverdrup's career in Norway and the United States provides insight into the cultural and political processes -- as well as human drama -- that entered into constructing the complex discipline known as oceanography.

**Plenary I**

**Oceanography Around the Pacific Rim**  
Wednesday, 7, July  
2:00 pm - 5:30 pm

Chair: Joseph Reid, USA

**Historical Account of Oceanography in Chile**  
Nibaldo Bahamonde, Academy of Sciences, Chile  
Tarsicio Antezana, University of Concepción, Chile

A historical review of oceanography off Chile may be traced from local aborigens and Spanish conquerors to present days. The development of oceanography is clearly focused (biased) toward natural history, exploration and exploitation of biological resources. It has also been stronger in coastal instead of

oceanic regions. Phases in the history of oceanography are tentatively identified, briefly described with the most meaningful events treated in detail:

a). Empirical knowledge of aborigens on harmful and useful species (earlier than XVII century).

b). Geographic surveys of travellers and explorers resulting in mapping, discovery of passages on the tip of South America and Antarctica (XVII-XVIII centuries).

c). Worldwide and deep ocean exploration resulting in species catalogs, basic biogeography (XIX century).

d). Local science begins with faunistic, floristic and geological accounting, the role of foreign naturalists (early XIX century).

e). Establishment of marine science begins with foundation of laboratories and marine stations, relevant university curricula and national research programs, cruises and basic national coordination (1940- ).

f). Ecological approaches and development of aquaculture in coastal regions (1960- ).

g). Recent historical development is drafted to emphasize persistent progress toward capability for open ocean ecosystem research and conservation of resources.

### *Half a Century of ORSTOM Oceanology in the South Pacific*

René Grandperrin; Jacques Daniel; Christian Henin,  
ORSTOM Center Noumea, New Caledonia

Francis Rougerie, ORSTOM Center Tahiti, French Polynesia

From 1947 to the late fifties, research conducted by IFO (previous name for the ORSTOM Centre in Noumea, New Caledonia) was mainly devoted to small scale ecology, to reef and lagoon species, to land geology and geophysics in New Caledonia. In the early sixties, open ocean surveys on pelagic primary production and physical oceanography were designed to increase the knowledge of the southwest tropical Pacific pelagic ecosystem. From 1965 on, the availability of the new modern R.V. "Coriolis" led to studies devoted to the Pacific Ocean area between the Coral Sea and French Polynesia and from 5°N to 30°S. Meanwhile, ORSTOM geologists and geophysicists met on the concept of plate tectonics and together initiated large scale surveys of the sedimentary basins and other tectonic features of the southwest Pacific. In addition, ORSTOM marine biology-fisheries research branches were set up in French Polynesia (Tahiti) and in Vanuatu (Port Vila) in 1976 and 1981 respectively. During the last decade, approximately 100 scientists and technicians were involved in studies devoted to: (1) the hydroclimatic international TOGA Programme, (2) the influence of hydrological conditions on pelagic production (PROPPAC Program), (3) the knowledge, functioning and exploitation of reefs, lagoons, atolls

and seamounts, (4) tuna and its environment, (5) islands arcs and the subduction process.

**Australian Boundary Currents:  
An Historic Handicap of a Modern Scientific Challenge**  
A.D. McEwan; E.A. Wood,  
CSIRO Division of Oceanography, Australia

Ever since its discovery by Captain Cook in 1770 the East Australian Current has been a frustration to sailors, presenting the combination of swiftness, roughness and unpredictability. The west Australian Leeuwin Current (named for a dutch vessel which first sighted the southwestern corner of Australia in 1622) although seasonal and weaker, is possibly the most extensive continental boundary current in the world. Furthermore it defies convention by flowing poleward.

Together these warm currents limit the biological productivity of much of the temperate coastal sea, and have been a factor in denying Australians the development of a maritime character.

The peculiarities of these currents have been the subject of long speculation, but it has taken modern oceanographic methods and physical understanding to provide a robust explanation for their many unique features. The present paper traces the path over the last 200 years from anecdote through clever observation to scientific analysis.

**The History of Oceanographic Studies in China**  
Wu Baoling, First Institute of Oceanography, Qingdao, China

The cause of the development of the ocean in China has a long history and tradition. In the ruined caves near Beijing of the Upper Cave Men who lived 18,000 years ago were found ornaments made from shells of bloody clams (*Arca* sp.) In the ages of the Xia, Shang and Zhou Dynasties (21-11 centuries B.C.) fishing gear and marine fishing boats were created and fishing laws initiated. Considerable progress was made in marine fishery, manufacture of salt from sea water and navigation in the area of the Qing, Han, Sui, and Tang Dynasties (221 B.C - A.D. 907). In the Han Dynasty (206 B.C. - A.D. 220) studies were made on tides, storm surges, tide forecast and observation. In the Later Tang Dynasty (A.D. 923-936) studies were made on ocean currents and atmospheric phenomena. The Kuroshio and monsoon action were utilized in navigation in the Yuan Dynasty (A.D. 1271-1368). In the Ming Dynasty the oceanic fleet of Zheng He (A.D. 1405-1433) reached the Pacific and Indian Oceans and the east coast of Africa, making a voyage of over 10,000 km. During the period from October of 1949 until the present marine research contingents have been established and research programs drawn up.

With the founding of the State Oceanic Administration, great development has occurred in marine science, technology and investigations.

### ***Pacific Ocean Exploration and Exploitation***

A. Alekseev, Pacific Oceanological Institute, Vladivostok

The main stages of the Pacific ocean exploration and exploitation are considered. The period under study covers XVII century up to nowadays. The materials are presented from the point of Russian scientific contribution into oceanography. The following stages have been distinguished when historical documents and materials were systematized and analyzed:

- the epoch of geographic explorations and development of navigation;
- first hydrographic expeditions during initial period of oceanographic observations;
- the period of complex oceanographic expeditions covering interval between the end of XIX century and the First World War - crucial period in the history of ocean studies;
- the stage of growing intensity in oceanographic investigation - the period between two world wars; the progress of Soviet oceanography - from studies of Far Eastern marginal seas to the global expeditions;
- development and maturing of oceanographic science on the Russian Far East; The status of the principal oceanographic organizations;
- results of some scientific projects and modern programs; bibliography on separate regions, data distribution schemes.

### ***History of Fisheries Science***

Yoshiaki Matsuda, Kagoshima University

The history of fisheries science in Japan is relatively new. The first lecture in fisheries science started at Sapporo Agricultural School in Hokkaido in 1880. It was taught by Dr. John Cutter from the United States of America until 1888 and succeeded by Shosuke Sato, Keishin Fujita and many others. At present, fisheries science is formally taught at 16 universities, 50 high schools and 3 other institutions. Besides, 10 national fisheries research laboratories are operating and 47 prefectures have fisheries experiment stations and other promotional institutions such as mariculture center and fisheries training school.

As a applied science based on the fisheries industry, its framework was rather limited to the fields of fisheries production, fish processing and aquaculture than that of the basic science. However, staff working in fisheries science are quite heterogeneous coming from different disciplines such as

basic science, agriculture, engineering, medical science and social science. Consequently, conflicts among different disciplines as well as between pragmatism and academism have been serious. As time changes, these fisheries institutions have been forced to change in quality.

***The History of Oceanography Along the Mexican Coast***

Richard A. Schwartzlose, University of California San Diego,  
Scripps Institution of Oceanography, and Centro de  
Investigaciones Biológicas  
Saúl Alvarez-Borrego, Centro de Investigación Científica and  
Educación Superior de Ensenada

The ocean along the pacific Coast of Mexico is an interesting and exciting place for research. The coastline is more than 6,000 kilometers long, varying from desert to tropical climates. There are: large lagoons; a deep sea trench; anaerobic varved sediments; volcanic activity; spreading centers with hot springs' hurricanes that develop in the south and move northward along the coast; a large diversity of fish; endemic and endangered species; large fisheries; huge tides; water temperatures that vary 25°degrees Celsius in one location between winter and summer; and clear skies for satellite observations. This variety has attracted international expeditions from the United States, Great Britain, France, Russia, Japan and Germany. There have been and are multinational programs with Mexico - The Deep Sea Drilling Program (DSDP), Food and Agriculture Organization (FAO), and Scientific Committee on Ocean Research (SCOR). Also there are programs between various research centers in Mexico and other countries. In a recent Gulf of California bibliography there are more than 8,000 references. There are articles in Spanish, English, Russian, Japanese, French, Italian and German. Located along the Pacific Coast of Mexico are four major and many smaller centers for research and education.

**Plenary II**

**Archival Resources for the History of Oceanography**

Thursday, 8 July  
9:00 am - 11:30 am

Chair: Jacqueline Carpine-Lancre, Monaco

***The Stazione Zoologica:***

***A Clearing House for Knowledge of Marine Organisms***  
Christiane Groeben, Stazione Zoologica "Anton Dohrn"

In December 1871, shortly after having moved to Naples, Anton Dohrn, the founder and Director of the Stazione Zoologica,

received a request from Jena for specimens of ascidians and Amphioxus. Similar requests soon followed and by 1876 more than 70 individual samples and collections had been sent to various parts of Europe. Dohrn then decided to exploit this branch of the Stazione's activity. He improved the Stazione's collecting techniques and hired the German chemist August Müller, an expert in preservation methods who passed his knowledge on the young Neapolitan, Salvatore Lobianco. Thanks to his extraordinary talent Lobianco was soon able to provide collections for courses, for research and to museums. These collections were prized for their precision and beauty. Lobianco's methods were kept secret for many years and sales profits sometimes reached 10% of the annual budget. Before World War I more than 7,000 collections of marine organisms were sent to laboratories, museums, scientific institutions, schools and private homes all over Europe, the United States and Japan. This fulfilled Dohrn's wish which was to bring Mediterranean fauna and flora to those who were unable to come to Naples.

***Resources for the Study of Oceanography at the Archives of the  
Scripps Institution of Oceanography***

Deborah Day, Scripps Institution of Oceanography

The author describes the history of the Archives of the Scripps Institution. This institutional archives primarily collects Scripps institutional records and historical manuscripts. The archives are used by three major groups of researchers, Scripps administrators, oceanographers and historians of science. The paper discusses what records should be collected to serve the research needs of each of these user groups and Scripps collection strengths and weaknesses with respect to the research interests of each group. The author concludes that it is difficult to serve the research needs of historians for two reasons. First, the history of oceanography is still an underdeveloped field. Second, the interdisciplinary nature of oceanographic activity and funding tend to scatter oceanographic documentation world wide. The author discusses ways that historians of oceanography can support science archives.

***Sources for the History of Oceanography at California Academy of  
Science and in the Pacific Northwest***

Pennington P. Ahlstrand; Thomas D. Moritz,  
California Academy of Sciences

Within the region comprised by Northern California, Oregon, Washington, British Columbia and Alaska, collections of materials relating to the historic development of oceanography on the west coast of North America will be reviewed. Extensive collections

of the personal papers of George Davidson (first author and compiler of the Coast Pilot's of the Pacific Coast) are held by Special Collections at the California Academy of Sciences and by the Bancroft Library at the University of California at Berkeley. Detailed attention will be given to these collections.

***Sources for the History of Oceanography at the Smithsonian Institution and National Archives***

Pamela M. Henson, Smithsonian Institution

The government of the United States has sponsored and participated in a significant amount of oceanographic research for economic, military and scientific reasons. Scientists at the Smithsonian Institution have often been involved in that research. The records of those activities at the Smithsonian Institution and National Archives provide rich resources for the history of oceanography. The U.S. Fish Commission and Bureau of Fisheries directed research on the whaling and fishing industries to enhance their economic potential. Spencer Baird, second Smithsonian Secretary, was also the first commissioner of Fishes. Records documenting research in fishing and whaling will be discussed, with Smithsonian collections highlighted.

The military establishment, especially the Navy, has sponsored scientific research on the oceans, and the National Archives contains most of the records of those researches. However, Smithsonian scientists often participated in Navy research projects, and Smithsonian collections document such expeditions as the Wilkes, North Pacific Exploring, Phoenix cruises and Crossroads Operation.

Smithsonian scientists have a long tradition of basic research in marine biology. Departmental records and papers of marine biologists will be highlighted.

Handouts will detail the major collections for history of oceanography at the Smithsonian Archives and National Archives and the guides to these collections.

***University of Washington Oceanography: History in the Archives***

James W. Markham, University of California at Santa Barbara

Records in the University of Washington Archives for the UW Oceanographic Labs and the UW Oceanographic Department cover the years 1929-1966. These records were examined to determine if they could provide information on three historical questions:

1. Many details emerged, some only indirectly, about the early years of the Oceanographic labs, from 1930 on, and the founding of the Oceanography Department in 1951.

2. The historical relationship between UW Oceanography and the Scripps Institution of Oceanography was revealed in many records.

3. For the activities of UW Oceanography during World War II, only tantalizing hints and indirect references could be found, as there is a gap in the records for the period 1942-1946.

#### Concurrent 1A

#### Oceanographic Books and Bibliography

Thursday, 8 July

1:30 pm - 3:15 pm

Chair: Pennington P. Ahlstrand, USA

#### ***The Oldest Oceanography Textbook:***

***In the 350th Anniversary of "Hydrographie..."***

***By Georges Fournier, Publication in Paris, 1643***

***Zdzislaw Mikulski, Warsaw University***

This paper describes "Hydrographie content la theorie el la pratique de toutes les parties de la navigation." This monograph can be seen as one of the first oceanographical publications. Fournier was born in 1595 in Caen, died in 1655 in La Fleche. He was Jesuit monk and carried research on the field of literature and mathematics. During his maritime travels with the French Royal Navy he has collected numerous materials related to geography of the sea, navy service, navigation and ships construction. The result of these experience was the book "Hydrographie..." and later publications on geography and engineering.

The title of the book suggests that the main topic is the navigation but its content is wider. In twenty chapters the following subjects have been described: ship architecture, organization of the French Navy, tides, navigation instruments and charts, and others. The contents of the book were very modern at that time and very soon was reprinted in 1667.

It is worth mentioning that the term "hydrography," which means science which describes a water occurrence on the earth, was used for probably the first time in this book. The term "oceanography" was introduced much later, in the middle of the nineteenth century. So far it has been taken for granted that the term "hydrography" was coined by Bernardus Varenius (1622-1650) in his book "Geographia generalis" published in 1650, Amsterdam.

The paper will be illustrated with photos of the front page, and some drawings from "Hydrographie...", from the Warsaw University library resources.

#### ***Bibliography of North-Western Pacific Oceanography***

**Alexander V. Tregubov, Pacific Research Institute of Fisheries and Oceanography, Russia**



In the Pacific Research Institute of Fisheries and Oceanography (TINRO) the most complete compilation of citations on available Russian and foreign publications concerning different aspects of oceanography of the North-Western Pacific published since the late 19th century through 1992 is prepared. The Bibliography contains over 2,500 citations on monographs and papers sorted alphabetically by authors and by subjects. The subjects taken into consideration are as follows: 1) Oceanographical Observations, 2) Air-sea Connections, 3) Temperature and salinity, 4) Optics and Acoustics, 5) Currents, 6) Vertical Movement and Mixing, 7) Waves (including internal) 8) Tides and Sea level, 9) Water Structure and Water Masses, 10) Hydrochemistry, 11) Biological Oceanology.

The area under consideration is bounded from the north by 45°N, from the south by 25°N, from the east by 170°E, and from the west by the Kurile, Japanese, and Ryukyu Islands. The main feature of the given area is the system of Kuroshio and Oyashio Currents, which interaction influences on oceanographical conditions of the North-Western Pacific and their variability. The main languages of the papers compiled are English, Japanese, and Russian. The most of the citations are supplied by abstracts. The Bibliography is available in both Russian and English.

#### **Concurrent 1B**

**Ocean Technology**  
**Thursday, 8 July**  
**1:30 pm - 3:15 pm**

**Chair: Robert Marc Friedman, USA**

#### ***Development of Research Vessel Design***

**George G. Shor Jr., Scripps Institution of Oceanography**

Research vessels, U.S. and foreign, academic and commercial, have strong similarities in many features. These came not from a single conscious design, but from an evolutionary process, over the period from the early 1960s to the present.

Prior to World War II, the few vessels built deliberately for research vessels were conversions. Most present-day research vessels have forward deck houses and many have shallow-draft hulls, derived from the fishing vessels of the U.S. Gulf Coast as modified for oil industry workboats. Decks open along one side, bolt-downs, seaworthy cranes, aft-controls, and dynamic A-frames came from the oceanographic institutions. Present designs were influenced strongly by arcane "tonnage" rules, need for reliability and redundancy in ships operating in remote area,

minimal manning to reduce costs, and the need for "flexibility" to change types of research.

Development of these designs involved the efforts of many naval architects, shipyards, oceanographic institutions, oil and geophysical companies, and government agencies; many ideas stem from work by Max Silverman and Scripps and Jon Leiby at WHOI.

### ***Swedish Oceanographic Instruments up to 1950***

Artur Svensson, University of Göteborg

Several Swedish instruments are described in McConnell's classical book. There are the waterbottles of Wilcke 1771, F. L. Ekman in the 1870's and Otto Pettersson 1894. Also included is Arwidson's current meter of 1879, but not his waterbottle of the same year, used daily in many decades at Danish and Swedish lightvessels. V. W. Ekman, the well-known theoretician, was also a constructor of instruments, particularly a current meter in 1905, but this work was done internationally for ICES in Kristiania (Oslo). Very much used in Sweden was the photographically recording current meter of O. Pettersson 1914, in a way a forerunner of Richardson's instrument 1963. This meter produced data in the 1930's which resulted in a much cited paper about inertial currents by Gustafson and Kullenberg. In the 1930's there were also constructed some optical instruments, and in the 1940's came Kullenberg's piston sediment core sampler. The latter one was used extensively on the Swedish circumnavigational cruise of "Albatross" 1947-48 to e.g. the Equatorial Pacific.

### ***Submersibles in Oceanographic Research: Six Decades of Discovery***

Bruce H. Robison, Monterey Bay Aquarium Research Institute

The utilization of undersea vehicles for scientific research began in the 1930's, with Beebe and Barton's *Bathysphere*. In the sixty years since these pioneering dives. Submersibles have played a significant but understated role in the evolution of oceanographic research. Most prominent among the discoveries attributable to submersibles are the spreading centers of the mid-Atlantic ridge, and the hydrothermal vent systems of the eastern Pacific. Beyond these high profile programs have been hundreds of individual projects that have greatly improved our understanding of how the ocean works. The fundamental value of submersible as research tools is that they provide a unique, in situ perspective in a discipline that is otherwise dominated by indirect methodologies. The progress of submersible-based research has been strongly influenced by the evolution of the technology; and in this area, the paradigm of science-driven technological development is clearly reversible. This paper addresses the role that manned and unmanned submersibles have

played in modern ocean science, with particular emphasis on the subs, the researchers, and their explorations in the Pacific Ocean.

***The Saga of the Tide Mills***

Roger H. Charlier, University of Brussels

Loic Menanteau, Laboratoire de Géographie Physique

After France built its sizeable tidal power plant in La Rance, near Saint Malo in Brittany, and the Soviet Union, China and Canada followed suit with smaller ones, a curtain fell on tidal energy harassing schemes. With the recent renewed interest in "ocean power" has come a growing concern for the forerunners of tidal power station: the historic value of tide mills is being recognized, perhaps buttressed by possibilities of reviving their use through modern versions.

In 1940, Rex Wailes wrote a remarkable historical and technological study of the tide mills of England and Wales. Only in the last decade have studies on other European countries followed (e.g. J.L. Boithius & A. de la Vernhe on Breton mills).

In the United States, where all but the Santa Cruz mill are on the Atlantic coast, individual mills have been described and a replica of a Bay of Fundy mill placed near the Annapolis-Royal power station.

The paper covers succinctly the implantation and development of tidal mills on the European Atlantic littoral (u.K., France. Spain & Portugal). Mills in the United States are briefly reviewed and sources for additional information provided. The different types of sites (estuaries bays, wetlands, slat-pans, etc.) and the infrastructures directly linked to the functioning of tidal mills (dykes, ponds) are analyzed and the problems of conservation dealt with.

**Concurrent 2A**

**Educational Mission of Marine Studies**

Thursday, 8 July

3:45 pm - 5:30 pm

Chair: James Sullivan, USA

***Educational Mission of Marine Science:***

***A Case Study of East Africa***

Selim Morcos, University of Alexandria

The East African Region has great potential in marine resources development, and encompasses interesting oceanographic phenomena that concern ongoing international programs, e.g. CCCO, WOCE, TOGA, JGOFS, and GLOSS. However, historically the marine

biologists were the first to be attracted by the coral reefs and rich biodiversity of the region.

Many efforts were made to foster regional co-operation. EAMFRO (East African Marine Fisheries Research Organization) lasted until the collapse of the East African Community (of Kenya, Tanzania and Uganda). The IOCINCWIO (Co-operative Investigation of North Central Western Indian Ocean of IOC) was started in 1976, and developed slowly through joint work between institutions inside and outside the region.

The contribution of scholars and universities from Europe and North America was the driving force behind many national and regional initiatives. The International Conference on Marine Resources Development in Eastern Africa, in Tanzania, in April 1974, was convened by the Universities of Dar-Es-Salaam and Rhode Island, USA. The Indian Ocean Panel of physical oceanographers participated in the formulation of the first IOCINCWIO Program and stimulated the work of the University of Miami on the East African current from the Institute in Mombasa. This was followed by a UNESCO/ECA (Economic Commission of Africa) regional project on marine science in the 1970's.

Training and education of marine scientists in East Africa was mainly carried out through bilateral projects which were formulated and encouraged by the marine scholars in the donor countries. The success of the Kenya-Belgium project is mainly attributed to the interest of the marine scientists of the Free University of Brussels (VUB) and other Belgian institutions. The Swedish SAREC has contributed both to the regional activities through its support of IOC programs, and to the national training and research program particularly in Tanzania, Mozambique and Somalia.

The relatively advanced state of marine science in East Africa is due to the combined efforts of national institutions, private scholarly initiatives, bilateral assistance and regional and international co-operation.

#### ***School and Popular Marine Science Education in the United Kingdom*** J. Malcolm Walker, University of Wales

In the United Kingdom, concern over the state of the marine environment has never been greater. Opportunities for education have thus been presented. By means of articles in newspapers and magazines, and through prime-time, current-affairs and overtly educational television programmes, the media have contributed and responded to the concern. The British educational system provides but limited Opportunities for children to receive formal marine education. For children aged 5 to 11, there is scope to incorporate marine studies in broad programmes of environmental education and generate a sense of wonder at the sea's National Curriculum and the syllabuses for public examinations contain little that obviously relates to the sea. With other

organization, the Challenger Society for Marine Science is endeavoring to advance the study and application of marine science and also to raise awareness of the need for proper management of the sea. An important consideration is that oceanography has a role in helping to improve science education as a whole and thereby helping to alleviate the present shortage of science education as a whole and thereby helping to alleviate the present shortage of science students in general and marine science students in particular.

***Early American Adventures in Marine Sciences Education***  
Keith Benson, University of Washington

Partly for pedagogical reasons and partly for financial reasons, marine stations along both the Atlantic and Pacific coastlines of the United States developed programs that traditionally emphasized curricula and educational offerings directed toward either audiences of primary or secondary school teachers or toward introductory courses for college and university students. In contrast, the early oceanographic institutions in the United States, the most prominent being at La Jolla and Woods Hole, lacked this same tradition. Perhaps the classic example of the lack of education within the early oceanographic programs is the marine station at Friday Harbor which, until it received the Rockefeller grant that established it as part of the "Oceanographic Laboratories" at the University of Washington, always maintained an active educational mission. As a result, the educational mission beside the sea was one that was restricted to marine biology institutions until the advent of the national SeaGrant program, which injected, for the first time, a general educational outreach to oceanographic institutions.

**Concurrent 2B**

**Oceanography In South Asia**  
Thursday, 8 July  
3:45 pm - 5:30 pm

Chair: Andrew Dickson, USA

***The Indo-Pacific Imprints on Oceanographic History***  
K. Krishnamurthy, Annamalai University

The oceans have captured the imagination of mankind since the dawn of history. They have served as the highway linking up countries, civilizations, spreading empire-building activities besides promoting trade and commerce.

The Indo-Pacific Region lies at the cross-roads of such maritime activities. The very name connotes the cumulative influence of the Indian and Pacific Oceans in establishing a scientific, cultural and commercial perspective in the annals of oceanographic history.

The region has served for spread of culture of various races, linguistics families, religions and for pursuit of adventure. The search for new oceanographic routes with pioneers like Colombus, Magellan, Vasco da Gama and Capt. Cook, besides early Arabian maritime contacts, have made this region as the main artery for spread of knowledge.

Various regional seas in the Indo-Pacific have also unique assets like seagrass beds, mangroves, coral reefs, fishes, besides fossil fuels. The Indo-Pacific Rim had a diversified biota, unique in many ways.

The monsoon and the mighty river enrich the culture of the peoples. The human interferences has also led to extinction of biota.

#### ***Development of Oceanography in Pakistan***

N.M. Tirmizi, University of Karachi

The Marine Waters of Pakistan are rich and as yet the resources are not fully utilized. There are also many phenomena which are of interest to oceanographers. Several Institutions and organizations are involved in the study of shore and offshore waters. The work is being done both locally as well as through linkage with other international organizations.

An overview of the development of oceanography in the country is given. The progress made and the present achievements are also briefly described.

#### ***Socio-Economic Impact of the Seas Around India:***

##### ***A Historical Review***

P.S. Srivastava, Society of Ocean Scientists and Technologists

This review discusses the economic utilization of the seas and coastal zone of India and their impact on the society during the following historical periods:

- |                       |                         |
|-----------------------|-------------------------|
| (a) Indo-Aryan        | (3000 to 600) B.C.      |
| (b) Pre-Muslim        | (600 B.C. to A.D. 1200) |
| (c) Muslim            | (1200 to 1757)          |
| (d) British           | (1757 to 1947)          |
| (e) Republic of India | (1947 to 1992)          |

'e' has been further sub-divided into the following periods:

- Pre International Indian Ocean Expedition (1947 to 1960).

- International Indian Ocean Expedition and Post I.I.O.E. (1960 to 1972).
- Post Discovery of Bombay High Oil deposits (1972 to 1992) A.D.

A critical review of the development of oceanographic sciences during each of the above mentioned periods and its interaction on socio-economic impact had been made.

### **Evening Lecture**

Thursday, 8 July

#### **Challenges and Opportunities in Naval Oceanography in the Post-Cold-War World**

Tim Coffey, Naval Research Laboratory

(no abstract available)

### **Plenary 3**

#### **Pacific Waters in Motion**

Friday, 9 July

9:00 am - 11:30 am

Chair: Kern Kenyon, USA

#### ***Duperrey's 1831 Chart of Oceanic of Oceanic Currents in the Pacific and the First Reports of the Equatorial Counter-Current During the First Half of the 19th Century***

Philippe Hisard, France

The "Carte du mouvement des eaux à la surface de la mer dans le Grand-Océan austral" by Duperrey (1831) is according to Kerhallet (1852) and to Puls (1895), the first map of the Pacific Ocean currents from ship-drift data since the era of the chronometric navigation. L. I. Duperrey was the chief of the "La Coquille" circumnavigation (1822-1825). He collected the ship-data for ten circumnavigations, from the second voyage of Cook (1772-1775) to the voyages of H. de Bougainville and the two by Beechey between 1824 and 1828.

Puls said that he has never seen the Duperrey's map and since that period very few authors quoted it most of them through Puls reference. We were able to find a copy of this map, quite serendipitously, at the Library of the Service Historique de la Marine at Vincennes (Paris). It was at the end of the seventh volume (cote 25 H 6) of the "La Coquille" narrative, but without any connections with the different chapters of this volume and without any comments by the author. We know, from Dunmore (1968) that the publication of Duperrey's works suffered from the

French Revolution during the year 1830. The size of the map is 23x37.5 cm.; it extends from 25°N to Antarctic and from 45°W to 135°W (as so the map documents also the Brazilian coastal and the Malvinas Currents).

Duperrey's map is the first which clearly documented the North Equatorial countercurrent in the central Pacific from the observations by Freycinet, on board "l'Uranie," 1819 and from observations by Duperrey himself in 1824 in the western Pacific. A puzzling feature of the map, is evidence of eastward currents to the south of the equator during both years. This representation was criticized by Meyen (as quoted by Puls). Today, it is possible to question for earlier evidence of the South Equatorial Countercurrent during the years when ENSO conditions prevailed. Such events could also have been responsible for the lack of any evidence of the NECC during the 1791 voyage of Marchand and the 1804 circumnavigation by Krusenstern.

***The Western Boundary Currents of the Pacific:  
The Development of Our Oceanographic Knowledge***  
Joyce E. Jones; Ian S.F. Jones, University of Sydney

The western boundary currents of the Pacific Ocean are strongly defined features of that ocean, and yet it was not until the early decades of the 19th century that they could be described in directories of navigation or drawn on charts by European geographers. We discuss the reasons why this was not achieved earlier, when it is clear that the Kuroshio current or its easterly extension, must have been encountered by mariners from Europe in the 16th, 17th and 18th centuries and may have been known to the littoral peoples from an even earlier time. The southward-flowing East Australian Current was not encountered by Europeans until late in the 18th century and was probably unknown to the indigenous people of eastern Australia. The contribution that Europeans made to describing and explaining the dynamics of these two currents is contrasted with that of the littoral peoples. The "closed country" policy of the large Asian nations was in sharp contrast to the expansionism of the nations of Western Europe and America. The surge of knowledge about the circulation of the Pacific in the first half of the 19th century is attributed to the development of new experimental techniques and the opportunities of voyages of scientific exploration and exploitation. A new theoretical framework of ocean dynamics led to another burst of activity in the second quarter of the 20th century. Economic exploitation of the ocean by fisheries provided some of the motivation for the studies of the mid-20th century.

***Pacific Waters and the Pog:***



***The Origin of Physical Oceanography on the West Coast of Canada***  
 Eric L. Mills, Dalhousie University

Viewed from the present, oceanography is a black box that reveals little of its origins. Viewed historically, oceanography becomes a network of shifting alliances and research programs owing all to its conditions of origin.

The most striking feature of Canadian Pacific physical oceanography before World War II is its absence. Only J. P. Tully of the Pacific Biological Station attempted (beginning in 1933) to link physical features of coastal waters to climatic control of fish stock abundance. Tully's first dynamical survey (1936) was a small part of a program that responded to demands as varied as occurrences of toxic molluscs and sewage on Vancouver beaches. Tully's physical oceanography (indeed all Canadian oceanography) solidified through the demands of World War II. Pacific and Atlantic Oceanographic Groups (POG and AOG) survived the war and prospered through the 1950's. The POG retained its link with fisheries management and prediction, but increasingly showed independence by working into the open Pacific, keeping old allies in biology but finding new ones within the well-developed communities of defence scientists and physical oceanographers in the USA. Canadian physical oceanography lagged that in the USA by twenty years because its origins were closely related to pelagic fish rather than to the oceans themselves.

***The Nineteenth-Century Charting of Currents in the Pacific Ocean***  
 Ray G. Peterson, Scripps Institute of Oceanography

The idea that anticyclonic circulations should in general prevail in the subtropical oceans began to emerge in the mid-1600s. But being that it was not demonstrable with available navigational techniques and that it was not compatible with long-standing theories of general westward motion, the concept was forgotten and remained dormant for nearly two centuries. When greatly improved methods of navigation became available in the late-1700s the best known and charted circulation was that in the North Atlantic, whereas the least known and uncharted was that in the Pacific. The first chart of currents in the Pacific (aside from speculative maps of the late Renaissance) was published by Duperrey in 1831. It revealed the major currents then known between 25°N and 65°S: eastward drift in the mid-latitude South Pacific bifurcating into the Cape horn Current and the northward Peru Current, the latter subsequently turning west into a broad Equatorial Current. Remarkable progress was made during the next two decades, in some respects outpacing what was being learned about the Atlantic. Berghaus' map of 1837 showed for the first time anywhere a portion of the North Equatorial Countercurrent, and it also showed the Kuroshio Current. The East Australia Current, flow through the Bering Strait, and most of the northern

subtropical gyre were shown by Wilkes in 1845. The southern subtropical gyre was depicted by Kerhallet in 1851 and the entire North Equatorial Countercurrent was traced by Findlay in 1853. Other maps were published in the following decades, but they often represented setbacks as opposed to progress until a notable improvement in detail was provided by Attlmayr in 1883. His chart was largely correct and it was improved upon by Kruemmel in 1887, the latter work serving as the standard until well into the twentieth century.

### ***The NORPAC Expedition of 1955***

Joseph L. Reid, Scripps Institution of Oceanography

In the summer of 1955 oceanographic research vessels of Canada, Japan, and the United States carried out a cooperative study of the area north of 20°N in the Pacific Ocean. The nineteen ships of from fourteen institutions in the three countries took 1,002 stations extending to 122 m depth.

The area of the measurements common to all ships were temperature, salinity, oxygen, phosphate and zooplankton, though several of the ships also measured silica and pH and several collected samples of phytoplankton.

The various institutions had a common interest in making the coverage systemic. The overlaps were few and the gaps in coverage limited only by the resources. The driving interests were in physical and biological oceanography. Each institution wanted a good coverage of the area of its own particular intersects but also recognized the value of extending the coverage far enough to relate its own area to the circulation and biogeography of the great ocean.

### ***Reflections on my Research in the Indo-Pacific, 1954 to 1992***

Klaus Wyrtki, University of Hawaii

Oceanographic research has made tremendous advances during the last few decades, and I had the pleasure to watch and participate in this development. When I left Germany in 1954 to go to Indonesia, I suddenly found myself in the middle of two oceans and at the center of the climate machine. My interest changed rapidly from studying deep ocean circulation to exploring the dynamics of the annual cycle and the monsoon circulation. Later at Scripps, I was confronted with the problems of upwelling along Peru and El Nino. After moving to Hawaii in 1964, I studied the response of the circulation of the Indian Ocean to the monsoons, and in 1971 I joined other scientists to start the NORPAX project, which finally involved me in work on the dynamics of the upper ocean, on climate variability and El Nino. Recognizing the need for an ocean monitoring system, I took the initiative to establish the Pacific sea level observing system,

from which important insights into upper ocean dynamics and El Nino resulted.

I will report on these developments from my own perspective and try to give an analysis of the trends in scientific thinking that were evolving during this period.

### Concurrent 3A

#### Expeditions and Exploration

Friday, 9 July

1:30 pm - 3:15 pm

Chair: Nathan Reingold, USA

#### *The Oceanographic Work of the Discovery, 1901-1931*

Ann Savours Shirley, Scott Polar Research Institution (Retired)  
and National Maritime Museum

Built in Dundee, Scotland, (where she is now berthed) for the British National Antarctic Expedition, 1901-04, the Discovery made three voyages to the Antarctic, during all of which she carried out oceanographic work. The first (1901-04) was organized jointly by the Royal Society and the Royal Geographical Society. Her commander was Captain R.F. Scott, R.N. She sailed via the Cape and New Zealand to the Ross Sea where she wintered in McMurdo Sound and completed the circumnavigation of the Antarctic, on her return voyage, making what are believed to be the first deep sea soundings in a high latitude of the South Pacific. The second voyage, 1925-27, organized by the Discovery Committee, was to the South Atlantic, making observations with a view to providing a scientific basis for regulations to protect the whale. The scientific director was Dr. S.W. Kemp later F.R.S. and the Master, Captain J.R. Stenhouse. She became the first ever Royal Research Ship (R.R.S.) at the start of this oceanographic expedition. Her third voyage was B.A.N.Z.A.R Expedition, led by Sir Douglas Mawson, F.R.S., during which a great arc of the Antarctic continent and Southern Ocean was navigated to the South of Australia, New Zealand and South Africa, 1929-31. The scientific results of all three voyages were considerable and were published.

#### *Memorial Research Vessel Vityaz:*

#### *Contribution in Oceanography (1949-1979)*

Svetlana S. Sivkova, Museum of the World Ocean

From 1949 till 1979 the R/V "Vityaz" was the leader of the Soviet scientific fleet. It made 65 expeditions, mainly in the Pacific Ocean. The vessel started to explore the bottom relief of the Pacific in 1957 (program of the International Geophysical

Year, project "Upper mantle of the Earth"). Unique deep-water winches allowed to define maximum depths of the ocean in 11 deep-water trenches, including the Mariana Trench. The possibility of life at depths more than 6 km was proven in 1949. About 300 kinds of animals unknown before were found. Pogonophora discovered by the vessel were classified as a new type (!) of organism. Pursuant to materials of the expeditions the scientific work "The Pacific Ocean" was compiled. The national oceanographical school was formed on board the ship. Scientists from 14 countries worked there.

In 1979 "vityaz" finished its last cruise in the port Kaliningrad (Baltic Sea). The decision on creating the Museum of the World Ocean on board the ship was made in 1991. The exposition will reflect 2 main subjects: history of the exploration and the contemporary notion of the ocean. The conception of the museum includes principles of "ecomuseum."

#### ***Mohole to the Deep Sea Drilling Program***

William A. Nierenberg, Scripps Institution of Oceanography

This is a narrative account of the development of the Deep Sea Drilling project at the Scripps Institution of Oceanography. It for underway under the grim shadow of MOHOLE and after two aborted starts. It is an outstanding example of institutional cooperation. The program started with a favorable scientific base and each of the early cruise legs had major impacts. They ranged from an oil dome at 10,000 feet in the Gulf of Mexico, clear evidence of sea floor spreading from the mid-Atlantic ridge to evidence for the pinching off at the Mediterranean at Gibraltar.

#### ***Sonar Investigations of the Geology of the Ocean Floor off the Hawaiian Islands***

J.B. Wilson; W.R. Normark, Institute of Oceanographic Sciences and United States Geological Survey

Bathymetric data obtained by echo-sounding methods where the navigational control was sufficiently good to be acceptable by today's standards was obtained from Hawaiian waters in the early 1950s. The earliest studies using side-scan sonar were undertaken with the Scripps Institution "Deep Tow" system on the northern Hawaiian Arch in 1966.

The SeaMARC II system developed jointly by the Hawaiian Institute of Geophysics and International sonar Technology (IST) first Commenced sea trials in 1982.

Following the successful initial surveys with the Institute of Oceanographic Sciences (IOS) long range side-scan sonar GLORIA off the East Coast in the early 1980's, a major contract was placed be the United States Geological Survey with the IOS in the

UK to jointly survey the Exclusive Economic Zone around the United States and its Trust Territories. The survey started with the US Pacific Seaboard in 1984. The survey from Hawaii in the east to Kure Island in the west commenced in 1988 and was completed in 1992. The results have revealed much that was hitherto unknown and unexpected about the geology of the ocean floor around the Hawaiian islands.

Side-scan sonar investigations using shorter range side-scan systems continue in Hawaiian waters including studies of the Loihi Seamount.

### Concurrent 3B

#### Leaders of Ocean Research

Friday, 9 July

1:30 pm - 3:15 pm

Chair: W. McBride, USA

#### **Andreas Sparrman 1748-1820**

David Dyrssen, Gothenburg University

Two disciples of Linné (1707-1778) joined Captain James Cook (1728-1779) on his first and second voyages, namely Daniel Solander (1733-1782) and Andreas Sparrman (1748-1820). Sparrman accepted an offer to accompany Captain Cook as assistant naturalist on Cook's second voyage with the ships Resolution and Adventure. This is perhaps the most remarkable voyage ever carried out (July 1772-July 1775). On the 1st of March 1775, Sparrman left the expedition at Cape Town in order to make a journey to the eastern parts of the southern Cape Province. In the second volume of his accounts in Swedish, Sparrman relates about the voyage with Cook. Lists in Swedish of Sparrman's collections in the Stockholm museums of Natural History and Ethnography are available. The purpose of the presentation is to summarize this material in English with special reference to oceanography. Earlier, the author has translated articles by Sparrman and Torbern Bergman (1735-1784) where Sparrman describes how he, on the 1st of July 1776, collected a water sample from a depth of 60 fathoms at 29° 27' N and 38° 21' Parisian meridian and Bergman describes the analysis of the sample.

#### **Secchi and His Disc**

H. Charnock, University of Southampton

Father Angelo Secchi (1818-1878) was a distinguished Italian astronomer. Perhaps his only oceanographic contribution was to a joint paper with Alessandro Cialdi (1807-1882) who had made

observations of the visibility of discs of various sizes and colors from a corvette, L'Immacolata Concezione, a vessel built for the personal use of Pope Pius IX.

Similar measurements had been made before but the Secchi disc became the accepted name for a simple white disc that could be lowered into the sea on line, the distance at which it was no longer visible being recorded as a crude measure of the ocean transparency.

Secchi disc observations were commonly, almost routinely, made in connection with hydrological stations for many years but then fell into disuse. Increasing interest in climate and climatic changes has led many to regret that long time series of Secchi disc observations were not maintained: the historical database of them is being related to satellite measurements of the chlorophyll content at the ocean surface.

***Prince Albert of Monaco and King Carlos of Portugal: Their Contribution to the Knowledge of the Atlantic Deep-Sea Fauna***  
Luiz Saldanha, University of Lisbon

By the end of the last century and the early 20th, the deep-sea Portuguese Atlantic fauna - Azorean and continental - was studied during the oceanographic cruises of Prince Albert I of Monaco and King Carlos of Portugal.

The two monarchs never worked together at sea but they were in permanent touch through their correspondence.

In a period of nearly thirty years Prince Albert cruised several times the Azorean waters. The deep-sea animals collected revealed several new species to Science and they were studied by well-known zoologists of that time.

D. Carlos studied in an admirable way the fauna of the slope and canyons of the Portuguese coast. His remarkable work was carried out with time shortage and practicably nonexistent scientific staff. His yachts were more modest in size and gear when compared with those of Prince Albert.

The activity of the two monarchs was a milestone in the knowledge of the deep-sea Atlantic fauna during the early period of European oceanography.

***George Wallace Melville:***  
***His Influence in Polar Exploration and in Ship Design***  
A. Aristides Yayanos, Scripps Institution of Oceanography

The career of Melville began with the U.S. Civil War and ended after the Spanish-American War. He distinguished himself on the Jeannette Expedition which failed to reach the North Pole and afterwards during the search for survivors in the Desolate Lena Delta of Siberia. Immediately after returning to the U.S., he went on the Greely Relief Expedition and further

distinguished himself. His book, "in the Lena Delta," discussing mostly these search and rescue efforts, includes a chapter proposing how to reach the North Pole. We can now compare Melville's proposal with Nansen's expedition on the Fram. As Engineer-in-Chief of the U.S. Navy, Melville chaired an international meeting of the Division of Marine and Naval Engineering and Naval Architecture of the International Engineering Congress, one of the congresses held at the time of the World's Columbian Exposition in 1893. In 1902 he directed a study on boilers for battle ships. The visionary Melville is perhaps no better evident than his report published in 1898 on the future importance of annexing Hawaii to the U.S. and on the "Nicaraguan Canal." This report effectively and succinctly predicts many of the world events of the 20th century. Melville's appreciation for scientific and engineering research and his own accomplishments make exceedingly appropriate the naming of Research Vessel Melville in his honor.

#### Concurrent 4A

#### Expeditions and Exploration: The Pacific

Friday, 9 July

3:45 pm - 5:30 pm

Chair: Bruce Hevly

**Allan Hancock Pacific Expeditions  
and Contribution to Marine Biology**  
Anwar Abdel Aleem, Alexandria University

Captain Allan Hancock was raised on Rancho LaBrea in L.A., known for its tar pits and dinosaur fossils. Early in life he developed the likening to animal life and navigation. Between 1917 and 1950 the Captain managed to build four ships (Valera I - IV) to explore the natural history of the Eastern Pacific.

Before 1931 little was known of the organisms living further out in the sea between low water and the 100 fm line which is the most fertile area of the sea.

Allan hancock investigations covered 27 volumes, apart from two volumes devoted to cruises. These volumes entailed over 10,000 pages, 900 plates and hundreds of new species and genera dealing with all groups of animal and plant life in the sea and notes on their ecology and distribution. This is in addition to the description of the topography of the sea bottom and water characteristics. The original specimens are kept at the Hancock Foundation in L.A.

The following remarks are worthwhile noting:

(1). There is exaggeration in describing new species, particularly in areas like the Baja California and Galapagos islands, which in certain cases reach as much as 30% of the total

number of species known in such areas. In justification, W. R. Taylor feels it is less damaging to do so than confusing different taxa under the same name. On the other hand, European investigators working on Hancock material were more conservative.

(2). John Garth working on crabs discovered that European as well as American type specimens or else in museums were destroyed by wars, fire, earthquakes or else damaged by disintegrating processes in time. He therefore suggested writing neotypes but was discouraged by the recommendations of the 14th International Congress of Zoology.

(3). It became apparent also that problems of Geographical distribution of fauna and flora inhabiting north and south eastern Pacific coasts still need elucidation.

***Samuel Stillman Berry and the R/V Albatross***  
 Larry T. Spencer, Plymouth State College

Delivered to the U.S. Fish Commission in 1882, the R/V Albatross plied the waters of the western Atlantic and eastern and central Pacific for 34 years. It was designed by Spencer Fullerton Baird and paid for by the U.S. government. It was then refurbished and used by Alexander Agassiz in his studies of the Pacific Ocean basin in the 1890's and early 1900's. Its final tour of duty came when Henry Bryant Bigelow used it for studies in the Gulf of Maine. Samuel Stillman Berry was born in 1887 and died in the 1960's. His publications begin in 1909 with an analysis of cephalopods collected by the R/V Albatross from the Hawaiian Islands and end with a paper in 1954 that describes some gastropods from a Pleistocene outcrop near San Pedro, California. In this paper I will describe the respective contributions of the R/V Albatross and S. Stillman Berry to the development of our understanding of the biology of the eastern Pacific Ocean cephalopod fauna.

***William Stimpson and Pacific Exploration, 1854-1865***  
 Ronald S. Vasile, Chicago Academy of Sciences

William Stimpson (1832-1872) was chief naturalist to the United States North Pacific Exploring Expedition (1853-1856). Stimpson's tireless dredging at various locales uncovered a wealth of new data on Pacific invertebrates. In addition, Stimpson was one of the first naturalists to systematically dredge off the Japanese coast. Over 12,000 specimens were brought home, comprising 5,300 species.

When the expedition reached San Francisco in October of 1855 Stimpson spent several months dredging off the California coast, and he described several new species of crustacea in the first volume of the Proceedings of the California Academy of Sciences. He followed up this initial survey the following year with one of



his most important scientific contributions, "On the crustacea and echinodermata of the Pacific coast of the United States." This was a first American attempt at cataloging the current state of knowledge of these groups.

The reports of the expedition were nearly ready for publication by Congress in 1861 when the Civil War shelved these plans. Most of the manuscripts and nearly all of the NPEE invertebrates were destroyed in the great Chicago fire of October 1871. Stimpson was dead of tuberculosis seven months later, and both he and the expedition are relatively unknown today.

**Major Results of the Investigations of the Danish Expedition  
(1928-30) in the Indo-Pacific**

Torben Wolff, University of Copenhagen

The termination of the publication of the grand Dana-Reports series offers an opportunity to review the background, accomplishments and particularly the results of the Dana Expedition. After having determined the breeding place of the European and American Eels, Johannes Schmidt wanted to investigate the life history of the Indo-Pacific fresh-water eels during a circumnavigation which should at the same time provide the first really comprehensive comparisons between the pelagic faunas of the three main oceans down to 2000-3000 m. Routine sampling for more than two years with mainly 1½-3 m ringnets at different depth levels yielded a total of 3700 samples. Sorting into 300-400 animal groups, corresponding to the framework of a publication, resulted in more than ½ million single samples; which also defrayed the cost of the expedition. The overwhelming richness of the Dana collections will be exemplified by the Hydromedusae; crustaceans such as ostracods, oxycephalid amphipods and eryonid deep-sea lobster larvae; the cephalopod *Spirula*; as well as the new fish order Mirapinnato, the deep-sea angler fish, the leptocephalid eel larvae, the lantern fishes, and the fish families Nemichthyidae, Paralepididae, Notosudidae and Giganturidae. Main results of the hydrographic studies will also be given.

**Concurrent 4B**

**Oceanography and its Publics**

Friday, 9 July

3:45 pm - 5:30 pm

Chair: Eric Mills, USA

**Whaling and the American Colonies**

Dale E. Ingmanson; William J. Wallace, San Diego State University

This paper will review the role of whaling in the American colonial economy with special emphasis on the period 1770-1775 leading up to the revolution. In addition, unreported data and information from unreviewed sources are provided and analyzed. A summary of possible economic courses of the initiation of the revolutionary war evaluated in light of recently documented significance of the whale oil trade in the colonial balance of payments.

***Sea Monsters: Myth or Genuine Relic of the Past***  
 Sherrie L. Lyons, Daemen College

Interest in sea serpents had a long history. Most often, they were regarded as creatures of myth and fairy tale. The eighteenth and nineteenth century witnessed the discovery of all sorts of fantastic creatures in the form of fossil remains. Real evidence of monsters who walked the earth and swam in the seas of ancient times brought a renewed interest in the existence of present day monsters. In the nineteenth century there is a dramatic increase in the number of sightings and I explore the relationship of this increase to the newly formed discipline of paleontology. I will document that a heated debate was going on in respected journals such as *Nature* and *Zoologist*. Lively discussions took place as to what kind of organisms these serpents were and what they could be mistaken for. How did these descriptions compare with what the ancient saurians were believed to look like from the fossil remains?

Charles Lyell had a serious interest in sea monsters and I argue that his interest was tied to his steady state view of earth history. Ultimately, however I think his theory of climate led him to conclude that relics from the past would not exist under present day climatic conditions. Lyell's interest, however, is not mentioned in any of his scientific correspondence. I use Lyell's interest in sea monsters to explore the question of whether sea monsters can be considered a legitimate area of scientific investigation in the nineteenth century.

***William Saville Kent, Auaria, and the Pacific Problems of Professionalization in Marine Science in the Late 19th Century***  
 Margaret B. Deacon, Southampton University

One of the profound changes in 19th century SCIENCE was the emergence for the first time on a wide scale of professional scientists, that is those for whom science was an occupation rather than an interest. Financial constraints upon marine science meant that in physical oceanography this change did not come about until after 1900. In British marine biology however it began somewhat earlier. The career of William Saville Kent

provides an excellent example of the kind of opportunities open to those seeking to make a livelihood in this field and the kind of problems they encountered. Up to that time most contributions had been made either by amateurs or by scientists whose principal work lay in more established areas. Kent was a career scientist who chose to work mainly in marine science, and who succeeded in doing so in the face of considerable difficulties. He was involved at different times with museums, aquaria, fisheries research, and the movement to found marine zoological stations. His career also took him abroad, to Australia and the Pacific, where he was one the first biologists to make a detailed study, using photography, of the Great Barrier Reef.

#### Plenary 4

**Beyond Darwin: Coral Reef Research in the 20th Century**  
 Monday, 12, July  
 9:00 am - 11:50 am

Chair: Daphne Gail Fautin, USA

***A New Kind of Expedition: Stanley Gardiner and Maurice Yonge in Coral Reef Studies - and Their Successors***  
 David R Stoddart, University of California at Berkeley

Several zoologists (including G. C. Bourne, S. J. Hickson and A. Willey) worked on coral reefs toward the end of the nineteenth century, but the major contribution was that of J. Stanley Gardiner (1872-1946). While his work was primarily faunistic he also contributed to 'the coral reef problem,' notably in *Coral Reefs and Atolls* (1931). His main expeditions were to the Maldives and Laccadives (1899-1900) and in the western Indian ocean (1905, 1908): these resulted in massive collections and publications. R. B. Seymour Sewell's John Murray Expedition (1933-1934) in the same areas was in a similar mould. Maurice Yonge (1899-1986), also a Cambridge zoologist, led a quite different kind of expedition: the Great Barrier Reef Expedition 1928-29, establishing a temporary laboratory on Low Isles, Queensland. It was not the first reef laboratory (the Tortugas Marine laboratory was built in 1904) but it was the first to place laboratory science at the center of expeditionary activity. Thus it laid the foundations of a new mode of investigation: Gardiner's expeditions were among the last in a tradition going back to Banks and Forster, Yonge's practiced a new kind of experimental reef science, as well as carrying on traditional systematic and geomorphological studies. Gardiner is now largely forgotten, whereas Yonge helped shape twentieth-century reef science in ways which this paper will explore.

***Pre-War Researches in Biology of Reef Corals in Japan, Especially in Palau and Formosa***

Siro Kawaguti, Kawasaki Paramedical School

In my oral presentation I want to limit my topics in only a small area. General features will be given in a poster or exhibition.

Main subjects are as follows:

1. Corals in an old sea-shore life in south-western Japan.
2. Situations of coral biologists in institutions.
3. Methods of observation on coral reefs in days of more than 50 years ago.
4. Kinds of equipments used for some experiments.

In the beginning of my study on reefs, I looked into corals and related organisms and wanted to hear from them. They have no voice by have body expressions. Then I tried to note their expressions.

***Operation Crossroads and the Drilling at Bikini and Enewetak***

Joshua I. Tracey, Jr., U.S. Geological Survey

The atom bomb tests of 1946, carried out by Joint Task Force I at Bikini, included a comprehensive scientific program to understand the geology, biology, and oceanography of the atoll and its marine environment by surveys and collections prior to and following the tests.

Commander Roger Revelle, who directed the Oceanographic Section of the Task Force, was largely responsible for planning and carrying out the program and enlisting the numerous scientists from government and private institutions. He again led the group to resurvey the atoll in 1947, to determine longer term effects of the tests. The resurvey included the drilling of several holes under the direction of Harry Ladd, one of which reached a depth of 1556 feet and bottomed in shallow water lagoonal sediments of late Oligocene age. In 1951 and 1952, Ladd returned to Enewetak Atoll to core several deep holes, one of which recovered a core of basalt from a depth of 4208 feet.

***The Biology of Coral Reefs From 1969 - Renaissance or Revolution?***

Patricia Mather, Queensland Museum

From the mid 1960s, concepts of coral reefs changed from static equilibrium systems dominated by specialized carnivores - the corals, to dynamic, flexible systems in which the dominant corals are autotrophic. Australia had a significant role in the development of the new coral reef biology, for it was in the 1960s that maturation and expansion of Australian universities, coinciding with the emergence of political conservation issues, dramatically increased people and opportunities for long term

investigations of the Great Barrier Reef. At the 1973 International Coral Reef Symposium, when Australia made its debut as an active participant in coral reef biology, the radical differences between new and traditionally held beliefs, already emphasized in a major environmental enquiry, were redefined. For new recruits to the field the symposium also dispelled their isolation from European and North American centres, established their identity, and gave them confidence to pursue the new directions their work and that of their successors would take over the next 2 decades. By the end of the 1970s, the Australian Institute of Marine Science, James Cook University and the Great Barrier Reef Marine Park Authority had been set up in Townsville, creating a new centre for coral reef research which is leading the world in understanding of coral taxonomy and reproduction, and of variations in spatial and temporal scales.

***Caribbean Contributions to Coral Reef Research,  
Big Fish - Small Pond***

Robert A. Kinzie III, University of Hawaii

Biogeographically, coral reef areas of the world are typically divided into the Indo-Pacific and the Caribbean regions. The most striking difference between the two is the vast difference in size. Caribbean reefs account for only 20% of the world's reefs. Nevertheless the level of scientific activity centered around coral reefs in the Caribbean makes up in intensity what it lacks in extent. Many of this century's leading coral researchers matured in this small tropical sea. Research stations from more than 13 nationals are occupied in reef-related studies in the Caribbean. Some of these have been, in one form or another, in existence since early in this century.

While the diversity of the reef biota in the Caribbean is, for many groups, less than the Indo-Pacific, many important discoveries have occurred there and some, but not all, generalizations that have been derived from reef studies in the Caribbean have been found to be applicable to reefs world-wide.

***Coral Reefs, Science and Politics: Links and Criteria for  
Decisions Since Two Centuries. A French Case History***

Bernard Salvat, Ecole Pratique Hautes Etudes

Faunistic and systematic studies of coral reef organisms during French colonial empire constitution in the XVIII and XIXth centuries represented the first interest accorded to reefs.

In spite of French presence in Indochina for over a century since 1859, important coral reef studies in south east Asia were not carried out.

In New Caledonia, the Singer Polignac Foundation and the national Museum of Natural History of Paris started an

interdisciplinary research programme on reefs from 1958 to 1964, the aim of which was cultural and scientific involvement for the Pacific of the same Director of the two institutions.

In Madagascar a research station at Tuléar was set up just when it acceded to independence in 1960. The scientific involvement of a Director from the Station Marine d'Endoume, Marseille, resulted in about fifteen years of publications on coral reefs.

In French Polynesia the decision in 1964 to set up the "Centre d'Experimentations du Pacifique" led to numerous scientific publications on the geology and ecology of Mururoa and Fangataufa atolls (Tuamotu) and neighboring islands. In 1970 was set up the "Antenne Museum EPHE" on Moorea whose programmes have focused for more than 20 years on the Tiahura zone of Moorea as well as other French Polynesia islands (Takapoto, Mataiva...). In the 1980's ORSTOM set up research programmes on Tikehau. While such a coral reef scientific activity since 1965 was much to team involvement, it started and developed according to political reasons and financial support.

As for the island of la Reunion (Indian Ocean) and Martinique - Guadeloupe (Caribbean) although a French presence existed since 1815, coral reef research did not start until the late 60's and early 70's with the implantation of Universities.

Other activities in the three oceans should be mentioned.

#### Concurrent 5A

##### History of Fisheries Management

Monday, 12 July

1:30 pm - 3:15 pm

Chair: W. Wooster, USA

##### ***One Hundred Years of the Sergestid Shrimp Fishery in Suruga Bay - Development of Jurisdiction and Social Policy Makoto Omori, Tokyo University of Fisheries***

Since 1884, a night fishery for the pelagic shrimp, Sergia lucens, had been conducted in Suruga Bay, Japan, via haul net. The history of the fishery of this small shrimp, 30-50 mm in body length, will be discussed in detail. The fishery is operated by members of two fishing unions under exclusive license from the Shizuoka Prefectural authority. Recently, the annual catch had fluctuated between 2500 and 3000 mt., and the average annual landing was more than 27 million dollars US, thus, contributing considerably to the local economy. Because the fishing ground is quite limited, historically there had always been intense competition between fishermen with high fishing effort and investment into fishing facilities. In 1977 the fishermen introduced a new system in that all members of the

union equally shared the sold value of the total landing of each night. They controlled the fishing activity including days, methods and amount of catch, totally. As the result, of reduced management went well, and this system is being watched with keen interest by many coastal fisheries in Japan.

***Scientific Management, Occupation Policy, and the Postwar Revival of Japan's Fisheries, 1945-53***

Harry N. Scheiber, University of California

Japan was the world's leading marine fisheries nation in the 1930's, accounting for 20 to 25 per cent of the entire global harvest from ocean waters. The devastation wrought during World War II virtually wiped out the Japanese deepwater fishing fleets, however, leaving the industry in a state of nearly complete collapse.

Soon after the Occupation began, however, General Douglas MacArthur as Supreme Commander for the Allied powers (SCAP), acting on the lead of the U.S. Government, decided to promote the rapid revival of Japan's marine fisheries should so as to maximizes the country's self-sufficiency in foodstuffs. (Later, the harvest of certain fisheries, most notably tuna, also became important for export earnings.) From 1946 to 1949, a series of SCAP orders reopened progressively larger regions of the Pacific Ocean to Japanese fishing. MacArthur meanwhile cooperated with the civilian government to undertake rapid rebuilding of the fishing fleets and to secure enactment of fishery reform laws. As the reconstruction effort went forward, the degree to which fisheries effort should be studied scientifically and then managed under "accepted principles of conservation" became a key issue within SCAP headquarters, between SCAP and the Japanese civil government, and within both the government and industry.

The central figure in seeking reform of fishery policy and institutions, and in promoting the idea of a commitment to scientific management was William C. Herrington, chief of the fisheries bureau of SCAP's Natural Resources Section. This paper concludes with analysis of Herrington's policies and their implementation. The impact of scientific management ideas both Japanese fishery industries upon emergent Japan-U.S. and Japan-Allied fishery diplomacy will also be examined.

***William C. Herrington and the Evolution of Ocean Management***

Amy L. Toro, University of California at Berkeley

The career and thought of William C. Herrington, a specialist in fisheries issues and an active participant in government and academia from the 1930's to the 1970's, reflect important changes in fisheries management. Throughout his life, Herrington was committed to the conservation of fish stocks and

was greatly disturbed by the massive overfishing of the twentieth century and worked vigorously to reduce it. Herrington retained a commitment to conservation throughout his life, but his strategies for accomplishing this goal were transformed.

The course of Herrington's thinking represented a shift away from a faith in international agreements to an increasing reliance on coastal state management. Herrington ultimately supported increased coastal state control, and idea which has been out in the movement from the three mile coastal zone to the 200 mile exclusive economic zone (EEZ).

Herrington also converted to a belief in the effectiveness of limited entry and private property regimes for conservation, solutions which economists had been advocating. Although Herrington did not embrace the economists' program in toto, he integrated it with existing ideas on fisheries management.

#### Concurrent 5B

#### Europe in the Pacific

Monday, 12 July

1:30 pm - 3:15 pm

Chair: Christiane Groeben, Italy

#### *Italian Contribution to the Knowledge of the South-East Pacific Ocean*

Norberto Della Croce, University of Genoa

Between 1866 and 1900, several ships of the Royal Italian navy sailed in the Pacific Ocean. Italian presence with naval divisions and stations was caused by the conflicts between different nations of the American continent and the Far East. Some of these ships carried out hydrographic surveys, collected specimens and made observations of different nature. The corvettes "Magenta" (1866-1869), "Caracciolo" (1881-1884) and "Vettor Pisani" (1882-1885) all completed the circumnavigation of the globe. The topics of the surveys dealt with sea phosphorescence, distribution of fish, birds and mammals observed or caught in both shallow and deep waters off the Chilean coast and the Straits of Magellan, collections of planktonic and benthonic organisms for which the military personnel had been trained in the Zoological Station of Naples. These collections and all other findings were donated by the Department of the Navy to various Royal Scientific Institutes. The hydrographic surveys mainly focused on the English Narrow, Hanover island (Caleta Rayo), the Western Canal (Caracciolo Bay) and Darwin Canal between Porto Lagunas and Yates. Other observations concerned specific areas where the Italian names of islands, bays, capes and gulfs in nautical charts are the living proof of Italian presence.



**Germania in Pacifico:  
Early German Contributions to Pacific Research (1741-1876)0  
Gerhard Kortum, Universität Kiel**

A new phase of German activities in the Pacific was opened by the circumnavigation of the German Imperial Navy vessel "Gazelle" (1874-76). Since then scientific enterprises were mainly based on economic and colonial interests in that area. As Germany was no maritime power before, scientists were involved in a number of expeditions of other nations. Since G.F. Steller's participation in Bering's cruise to the Northern Pacific in 1741-42, especially Russia made extensive use of the high potential of German natural historians in the 18th and the beginning of the 19th century. A considerable number of the scientists accompanying Russian sponsored expeditions to the Pacific came from the Baltic states and had a German cultural background. But other nations were involved as well. As J.R. and G. Forster's important contributions to Pacific research show. Valuable information was collected by the Russian Sea Trade Association ships 1822-44, which were evaluated and published later by H. Berghaus, a noted cartographer of that time with broad hydrographic interests.

For the first time A.V. Humboldt's Pacific voyage from Callao to Acapulco (December 24th, 1803 - March 22nd, 1804) and its scientific results are studied in detail. Furthermore A.V. Chamisso's remarkable report on the "Rurik"-Cruise (1815-18), which belongs to the best travel accounts in German literary history, is analyzed in the general context of physical geography, marine sciences and natural history in general.

**The Approach of Alfred Merz (1880-1925), Georg Wüst (1890-1977),  
and Albert Defant (1884-1974) to Pacific Oceanography  
Walter Lenz, Universität Hamburg**

Immediately after World War I Merz and Wüst started to collect and analyze all available oceanographic data from the entire world ocean to establish a general picture of ocean circulation. Having failed to get financial support for a German Pacific expedition proposed by Merz - as alternative and not so expensive the South-Atlantic-METEOR-Expedition (1925-27) was conducted - Wüst and Defant continued to argue for an exploration of the Pacific - this time on an international level. They called for a conference "Systematic Exploration of the World Ocean" in Berlin in 1928, which was attended by delegates from 28 different countries. They also presented proposals at other meetings like the 4th Pacific Science Conferences in 1929 announcing that it should "be solved by the friendly collaboration of all nations." By then, the scientific leading

countries in that area, USA and Japan, were not ready for such and undertaking. However, almost 10 years later their proposals were remembered due to the highly appreciated effort of the evaluation of the METEOR-Expedition. The outbreak of World War II stopped the just started planning for an international exploration of the Pacific.

***Investigation of the Humboldt Current Following a Long Series of Misadventures. The Voyage of the R.R.S. William Scoresby May - August 1931***

Rosalind Rolfe Gunther Marsden

The original aim of the Discovery Committee was to research the biology/ecology of whales with a view to conserving the whaling industry. In late January 1931 the Admiralty representative on the Committee proposed that the William Scoresby, then on a whale marking cruise in the South Georgia area, survey the Humboldt current. Her Southern winter programme was change. In spite of "the eternal struggle against the friction of environment" 120 stations were worked in 5 months. A report, "Oceanographical investigation in the Peru Coastal Current" by F.R. Gunther. Discovery Reports Vol. XIII pp. 107-276, Oct. 1936. was the result. This paper will examine some of the delights and difficulties encountered during the investigation both in the work and in the dual control by Senior Scientist and senior Marine Staff together with the problems of remote control by the Committee and Government Departments in London as shown in the papers of Rolfe Gunther and Sir Sidney Harmer.

**Concurrent 6A**

**History of Fisheries and Marine Products**

Monday, 12 July

3:45 pm - 5:30 pm

Chair: Harry Schieber, USA

***The Evolution of Ideas on the Mechanisms of Amphiline Telrost Migrations***

Maurice Fontaine, Institut Oceanographique

Amphihaline fish (e.g. Eels, Salmon) were long thought when accomplishing their migrations, to be guided essentially by certain tropisms. The difficulties arising in the adoption of this concept will be described.

Today it appears that these migrations should be decomposed into several stages. The corresponding behaviors can differ greatly but usually depend on the presence or absence of conflicting relationships between environmental conditions and

physiological states. For instances, departure on a catadromous migration is due, at least partly, to a decline in the osmoregulation processes when confronted by a hypotonic medium (freshwater), determining the fish to leave a medium no longer suitable. Swept down by the current, it then arrives in new environment more in harmony with its new physiological conditions, where finally, guided by certain mechanisms discussed, it reaches a stage essential for the maintenance behavior is oriented by one particular tropism (e.g. hydrotropism for the alver, tropism by olfactive reception for the Salmon).

Lastly, some important problems still remaining will be evoked, for the history of sciences, by the teachings of the past, must pave the way for research of the future.

***The Uses and Abuses of Scientific Expertise in English Inshore  
Oyster Fishery, 1860-1900***  
Gil Parsons, Lancaster University

During the nineteenth century the public oyster fisheries of England were state property in that the right of the sea bed existed in the Crown as trustees for the people in common. No management of public oyster beds was undertaken by the Government during the first half of the nineteenth century other than three Parliamentary Bills to help protect the beds. The open-access status of the beds was restricted only by the parochial politics of the local communities, and passage of time served to translate usage interests in the resource into claims on the resource, and the claims into property rights. During the latter half of the nineteenth century eighty-two Parliamentary Papers were published to facilitate the establishment, maintenance and improvement of these common property resources.

During the Commissions and Inquiries that led to these Printed Papers, scientific expertise was used selectively by Government, Companies, Individuals and Communities alike - whoever paid the piper, called the tune. The conflicting evidence only served to allow the adjudicator(s) to exercise their own personal and political preferences.

The two most important nineteenth-century Acts were, 1) the Oyster & Mussel Fishery Act, 1866, which enables the state common property rights to be converted to either private property or communal property rights and, 2) The Sea Fishery Regulation Act, 1888, which created the Local Sea Fishery District Committees but severely limited their regulatory powers. Both are good examples of how scientific expertise was mobilized, used and abused by all parties.

***Huxley's Red Herring:***  
***T.H. Huxley and Early Twentieth-Century Fisheries Biology***  
Jennifer M. Hubbard, University of Toronto

Biologists who denied the reality of overfishing were quite commonplace in the first half of this century. Many fisheries biologists truly believed that no amount of fishing could ever seriously harm fish stocks of the open oceans. Indeed, claims for the inexhaustibility of the fisheries cropped up frequently amongst fisheries biologists from many nations. This was in strange contrast with the whole idea of overfishing (and concerns for fish depletion from whatever cause), which led many scientists to the sea in the first place. A likely explanation for this anomaly lies in the person of Thomas Henry Huxley.

Thomas Henry Huxley's name hardly conjures up images of the fisheries, but in truth Huxley exerted an enormous and pathological influence over fisheries science, one that lasted to the middle of this century. This influence was out of proportion to Huxley's slight involvement with early fisheries biology. Huxley's declarations that the open-sea fisheries were inexhaustible, and fishing could in no way compromise the extreme fecundity of the oceans, were enshrined by certain scientists, and helped to delay by decades conservation-based policies in several countries.

***Ocean Food and Energy From California Mariculture: An Evaluation of the U.S. Marine Biomass Project From 1972 to 1986***

Peter Neushul; Lawrence Badash,  
University of California at Santa Barbara

During the energy crisis of the early 1970's, government and private agencies began funding research on alternatives to fossil fuels. Among the projects was a 20 million dollar marine biomass program to develop a large Ocean Food and Energy Farm (OFEF) as a source of raw material for generating methane and other products. Research began in 1972 and continued until 1986, when funding for the project ended abruptly. Yet, with the continuing depletion of fossil fuels and the added concerns about carbon dioxide and global warming, marine biomass remains as a potentially limitless alternative to current finite resources. Unlike fossil fuels, marine biomass removes carbon dioxide from the atmosphere and oceans converting it, via photosynthesis, into chemical energy. As energy and environmental concerns increase, US and international interest in large-scale macroalgal mariculture is also expected to grow. Unfortunately, there has been no careful assessment of the marine biomass program that ended in 1986. Our objective, therefore, was to review the published and unpublished reports generated by the marine biomass project and to interview key scientists and engineers involved in the project. The goal was to learn what went wrong, and suggest a direction for future success.

Concurrent 6B

**Oceanography: The American Context**

Monday, 12 July  
3:45 pm - 5:30 pm

Chair: Duncan Agnew, USA

***Selling Bellevue: The Emergence of Naval Oceanography in the United States, 1914-1924***

Gary E. Weir, U.S. Naval Historical Center

This paper will offer an analysis of U.S. Navy's decision to make a commitment to oceanography during and immediately after the Great War. The challenges of the war at sea, especially the U-boat threat, prompted the Navy to go beyond coastal surveys, hydrography, and mapmaking. A better understanding of the blue-water environment that was the navy's natural habitat suddenly became a requirement for victory at sea. Oceanographic research brought together scientific talent with diverse skills and interests to address problems like underwater acoustics and submarine warfare in conjecture with the National Academy of Science, the National Research Council, naval scientists, and private industry.

The history of naval oceanography only began with America's brief involvement in the war. In 1923, the Navy Department followed the lead of Dr. Harvey Hayes of the Navy's Engineering Experiment Station (EES) and inventor of the sonic depth finder. He suggested that a continued commitment to oceanographic research would demonstrate, in an age of naval disarmament, the Navy's peacetime utility to a war-weary public and skeptical Congress. His initiative aroused a very positive response and set in motion a number of naval programs in support of oceanographic research during the interwar period.

***Marine Biology or Oceanography: Early Developments in Marine Science on North America's West Coast***

Keith R. Benson, University of Washington

Three marine stations were opened between 1892 and 1904, Hopkins Seaside Laboratory, the marine station of the San Diego Marine Biological Association, and the Marine Station of the University of Washington. All three stations were originally organized around a marine biology and marine botany curriculum. However, William Emerson Ritter had a different ideal in mind for his station in San Diego. For twenty years, Ritter pursued the development of an oceanographic institution that was distinct from the other two stations, patterned instead after ideas Ritter borrowed from W. A. Herdman. The distinctive character of Ritter's undertaking and the subsequent move in the mid-1920s to

add oceanography at Pacific Grove and Friday Harbor offer a fascinating study of the early attempt at a demarcation between marine biology and oceanography.

***Marine Biology/Biological Oceanography and the Federal Patron:  
The NSF Initiative in Biological Oceanography in the 1960S***  
Toby Appel, University of Florida

My paper argues that the relation of marine biology to biological oceanography in part depends on where financial support is coming from. Not only does the federal agency matter, but the location of the funding within the agency. In 1960, the staff of NSF's Division of Biological and medical Sciences (BMS) undertook to promote "biological oceanography" by making it an area of special emphasis in the Division. BMS became the major federal patron of biological oceanography in the 1960s.

According to the rhetoric adopted by the BMS staff and its appointed advisors, there was no difference between biological oceanography and marine biology. Biological oceanography was broadly defined as the study of life in the sea, and the sea went from shore to shore. Through the 1960s, biological oceanography was funded together with marine biology in BMS while physical oceanography was located with the physical sciences.

The close relations between marine biology and biological oceanography at NSF were abruptly severed in 1970, when in response to the funding crisis, the NSF upper hierarchy removed biological oceanography -- both ships and individual grants -- from BMS. Biological oceanography was joined with physical oceanography in the Division of Environmental Sciences while marine biology remained in BMS.

***The Role of Spectral Representations in Ocean Wave Physics***  
David Irvine, Hughes STX/NASA

Toward the end of the Conference on Ocean Wave Spectra, held in Easton, Maryland, in May 1961, Walter Muck characterized the state of ocean wave physics: "during the past ten years, the subject has gone from an art to a science. One way of indicating the enormity of this change is to point out that in these past three days I have yet to see a slide shoeing a wiggly wave record plotted against time! It used to be ... people would shoe thousands of slides plotting sea level against time." Ocean surface for more literal ones - wiggly wave records.

Why did spectra become so popular? Which features of the spectrum have been studied, and which ignored? Once people had decided that a spectrum was the right thing to study, what part did the actual observations of ocean wave spectra play in subsequent deliberations? This paper will pursue these questions in an investigation of the role of ocean wave spectra in the

study of ocean wave. The proceedings of the Easton conference will provide the primary source material.

### **Evening Lecture**

**Monday, 12 July**

#### ***Oceanography: The Next Fifty Years***

**John A. Knauss, National Oceanic and Atmospheric  
Administration**

Speculating about future developments in any science is fun but risky, but of one prediction I am reasonably certain. There will be no less interest in the ocean in fifty years than there is now. I expect there will be more. If the past provides a key to the future, then with some notable exceptions for example those generated by the plate tectonics paradigm, the fundamental questions oceanographers will be asking fifty years from now will not be much different than those being asked today, which in turn are not that much different than those we asked fifty years ago; for example, what controls biological productivity? how does the ocean interact with the atmosphere? From its very beginnings finding answers to those questions has been mostly controlled by available technology. Fifty years ago the rate at which meaningful observations could be made was painfully slow. In some, but not all, fields of oceanography that has dramatically changed, but these new observations require reformulating these fundamental questions, and answers to these reformulations await further developments in technology. Certain technical advances can be expected: satellite sensors, ship design, automated instruments, improved batteries or other energy sources, greater ease at working at great depth because of materials development, etc. But there will be many surprises that this commentator cannot foresee, just as I believe it unlikely that any oceanographer could have foreseen fifty years ago the technical advances in satellite development, microelectronics, and computer power and miniaturization that have so influenced today's ocean technology. As in the last fifty years advances in fields far removed from traditional ocean technology will have an extraordinary impact on what our field will look like fifty years from now.

### **Plenary 5**

**Continents vs. Oceans in the Earth Sciences Revolution**

**Tuesday, 13 July**

**9:00 am - 11:45 am**

**Chair: Robert Parker, USA**

**Gravity Surveys in the "Permanent" Ocean Basin:  
An Instrumental Chink in a Theoretical Suit of Armor**  
Naomi Oreskes, Dartmouth College

In the early 20th century, James Dana's work on the permanence of ocean basins was considered one of the major theoretical contributions of American science. In challenging the notion of static ocean basins, Alfred Wegener's theory of continental drift thus struck at the heart of American scientific pride. The result of his direct attack was rancorous dispute.

Yet, at the same time, a group of American earth scientists were indirectly casting doubt on the Danian view, by extending the existing traditions of continental geodesy into the marine realm. This extension was made possible by an instrumental innovation which permitted the measurement of gravity at sea - a previously impossible task. The primary motivation for measuring gravity at sea was to improve estimates of the figure of the Earth, and to test the theory of isostasy over the ocean floor. But the scientists involved also recognized that the discovery of significant isostatic anomalies would be evidence against a static ocean floor. In the event, measurements of gravity-at-sea did reveal major anomalies; these results became justification for a large-scale scientific research effort, focused on the ocean basins, which ultimately overturned the Danian view. However, by focusing on the instrumental technique, rather than on the theoretical issues at stake, the scientists involved avoided theoretical dogfights at the onset of their investigation, and made progress which might otherwise have been impeded by protectiveness and pride.

This suggests that one important reason for the valorization of instrumentation in scientific work is that new forms of data and instrumentation provide rare options for conceptual flexibility, because they lack an established relationship to existing theoretical belief.

**Evolution of the Tectogene Concept, 1930-1965**  
Alan O. Allwardt, Rogers Johnson & Associates

The tectogene, or crustal downbuckle, was proposed in the early 1930's by F. A. Vening Meinesz to explain the unexpected belts of negative gravity anomalies in island arcs. He attributed the isostatic imbalance to a deep sialic root resulting from the action of subcrustal convection currents. Vening Meinesz's model was initially corroborated experimentally by P. H. Kuenen, but additional experiments by D. T. Griggs and geological analysis by H. H. Hess in the late 1930's led to substantial revision in detail. As modified, the tectogene provided a plausible model for the evolution of island arcs into alpine mountain belts for another two decades. Additional



revisions became necessary in the early 1950's to accommodate the unexpected absence of sialic crust in the Caribbean and the marginal seas of the western Pacific.

by 1960 the cherished analogy between island arcs and alpine mountain belts had collapsed under the weight of the detailed investigations by Hess and his students in the Caribbean region. Hess then incorporated a highly modified form of the tectogene into his sea-floor spreading hypothesis. Ironically, this final incarnation of the concept preserved some of the weaker aspects of the 1930's original, such as the ad hoc explanation for the regular geometry of island arcs.

### ***The Plate Tectonic Revolution: The San Andreas Bridge Between Oceanic and Continental Tectonics***

**Tanya Atwater, University of California at Santa Barbara**

The plate tectonic revolution began in the mid 1960's with the virtual proof of sea floor spreading and the realization that all the crust of the deep oceans had been created by that process. The concepts of subduction and of rigid plates filled out the story, but these too applied primarily to the oceanic realm. Continental crust evolves by much more complex processes and continental tectonic activity is often only poorly approximated by rigid plate descriptions. Thus, by the end of the 1960's most land geologists had heard the excited rumblings emanating from the oceanographic institutions, but the ocean-continent dichotomy kept them as bystanders. The San Andreas Bridged that gap.

The San Andreas fault system is the present location of the Pacific-North American plate boundary, but that boundary is relatively new. It originated and grew as the result of a complex interaction between the spreading centers and subduction zones offshore. Thus, the evolution of this important continental tectonic feature is intricately entangled with oceanic plate history and is predictable from ocean floor data. Because of this deep interrelationship, the San Andreas evolutionary story and teach about oceanic tectonics and about plate tectonic theory in general.

### ***The History of the Terrane Concept: Continental Geologists Strike Back***

**Homer LeGrand, The University of Melbourne**

Plate tectonics gave in the early 1970s elegant explanations for the ocean basins and for trans-Atlantic geological correlations. Its utility was less obvious to geologists working elsewhere. How could apparent similarities between western North America and other Pacific regions be explained if the Pacific had been an open ocean for at least the last 600 MY? How could one

explain the complexities of the continents, the apparently senseless jumble of the American Cordillera, with such a simple model developed for the seafloors? One response to the threatened invasion of the continents by ocean-based theorists was the concept of "suspect" or "accreted" terranes; i.e., the view that large parts of many Pacific Rim landmasses are collages of fragments of continental and oceanic crust which originated elsewhere and have been transported, rotated, broken, stretched and eventually "plastered" or "sutured" to the older shields or cratons. Most of the initiators and leading proponents of terranes are specialists in the geology of western North America and associated with the USGS Western Region headquarters at Menlo Park, California: Menlo Park mafia." Many of them regard their program as an alternative to overly simplistic plate tectonic model based on the ocean floors. In their view, the terrane approach addresses the complexity of the continents, reaffirms the importance of detailed, careful field-work, and eschews grand interpretative frameworks.

#### Concurrent 7A

#### Chemistry of the Oceans

Tuesday, 13 July

1:30 pm - 3:15 pm

Chair: Karl Hufbauer

#### *The Development of Our Understanding of the Carbon Dioxide System in Sea Water*

Andrew G. Dickson, Scripps Institution of Oceanography

The development of our understanding of the carbon dioxide in sea water draws heavily on basic chemical concepts of aqueous speciation and of chemical thermodynamics. Both these areas changed rapidly in the late nineteenth and early twentieth centuries, and the published application of such concepts in Marine Chemistry lags as much as twenty years behind their introduction in the parent field of chemistry

A Study of the relationship between the theoretical and experimental directions taken in the field of Marine Chemistry and the contemporary studies being conducted on related problems in the larger field of Chemistry thus provides an illustration of the isolation of marine scientists at that time.

I propose to use this approach as a tool to examine the early development of Marine Chemistry as a discipline in its own right - separate from Chemistry - and to speculate on the role played by the geographic as well as intellectual isolation of marine scientists in the eventual development of the field.

***Early Attempts at Determination of the Salinity of Seawater From  
Measurements of its Electric Conductivity***  
Jens Smed, Denmark

In the late 19th century two methods for determination of the salinity of seawater had been developed to considerable accuracy, viz., from measurement of the density and of the chlorinity of the water, respectively. A method for determining the salinity of a sea water sample from its electric conductivity was worked out by Tornøe and used by Nansen during part of his North Polar Expedition. An instrument, also based upon the measurement of the electric conductivity, was designed by Knudson for determination of salinity and temperature in the sea without collecting water samples or pulling the thermometer cut of the water to read it. The method was especially suitable for determining the depth of the discontinuity layer. Some interest was in the 1920's shown by British fishery scientists and by the British Navy. The interest would seem to have petered out however, without any results being reached. Convenient instruments for obtaining profiles of salinity and temperature could not be developed before the late 1940's when advanced electronics had become available.

***The History of Chemical Determinations of Salinity***  
William J. Wallace, San Diego State University

The most important test for the presence of "salt" (chloride) in sea water has always been that of silver nitrate. Known as a sensitive reagent since the sixteenth century this test was not regarded as quantitative until Gay-Lussac in 1832 who also introduced a volumetric technique.

By 1895 three methods were in use to determine the amount of chloride in a sea water sample. In the next seven years one method would predominate and would so until the present time. Since 1902, only a few procedural additions have been added to facilitate the determination.

***The History of Chemical Oceanography in Australasian Waters***  
Andrew McTaggart, Tasmania University

This paper examines the historical development of chemical oceanographic research in Australasian waters. Since the colonisation of Australia in the latter part of the 18th century, interest in chemical oceanographic research by Australians has only begun in the last 50 years. The development of a national fisheries investigation section in 1937 by the Commonwealth Scientific and Industrial Research Organization (CSIRO), fostered the initial growth in chemical oceanography in Australia have begun to take interest in research in all facets

of marine chemistry. This paper will discuss the Australian chemical oceanographic investigators and their research in Australian coastal and southern Ocean waters.

#### Concurrent 7B

**National Contributions to Oceanographic History: Eastern Europe**  
 Tuesday, 13 July  
 1:30 pm - 3:15 pm

Chair: Walter Lenz, Germany

***The Pioneers of Oceanographic Research in Romania***  
 G. Serpoianu, Romanian Marine Research Institute

The first notable cases of Romanian oceanographic research are linked by the names of three famous naturalists, highly appreciated in their time in Europe and worldwide.

Dr. Gr. Antipa (1867-1944), after graduating from universities in Romania and Jena (Austria) he worked for a year in marine stations in Villefranche-sur-Mer and Naples. In 1893 he carries out the first Romanian oceanographic cruise in the Black Sea. He was vice-chairman of ICESM. In 1932 he founded the Bio-Oceanographic Institute in Constantza.

Professor Emil Racovita (1868-1947) became well-known in the field of oceanography by his attending the cruise of the ship "Belgica" in 1897, to the South Pole. His faunistic collection was studied by numerous naturalists who gave his name to some new species.

Professor Ioan Borcea (1879-1936), after graduating from the University in Romania, obtained a doctoral degree at Sorbona, and after that he was granted by marine stations from Roscoff and Naples. He worked in many fields of biology and remarked himself by his studies on marine fauna from the Romanian littoral of the Black Sea, but especially by the founding in 1926 of the first Institution of Marine Research in Romania, Zoological Station - Agigea.

***Romanian Development Contributions From E. Racovitza and G. Antipa to Scientific Exploration of the Mediterranean Sea***  
 Alexandru S. Bologa, Romanian Marine Institute  
 Alexandru Marinescu, Museum of Natural History

The International Commission for the Scientific Exploration of the Mediterranean Sea (ICSEM) played an important part in the co-ordination for the research activities in the Mediterranean basin, at the same time laying the foundation of the first international collaboration in the oceanographic field.

From the beginning Romania participated in all events of the Commission. The first Romanian representative was Emil Racovitza (1868-1947) who enjoyed a high scientific reputation as an oceanographer, Antarctic explorer and researcher of the underground domain (the founder of biospelaology). His official appointment was in 1925, but E. Racovitza participated in the sessions of the Commission beginning in 1919. Overpowered by the numerous obligation from his own country, E. Racovitza proposed Gregory Antipasti appointment for the National Committee of Romania. G. Antipode (1867-1944) made the first explorations of the Black Sea in 1893. Then he became, not only a great expert of that sea, but also a distinguished specialist in the study of the Danube and the Danube Delta.

The Romanian contribution to the activity of this prestigious scientific body is sustained by official documents, come of them original, but also by data from the correspondence between e. Racovitza and from Antipasti original letters.

#### ***Four Centuries of Physical Oceanography in Croatia*** Mirko Orlic, Scripps Institution of Oceanography

The development of physical oceanography in Croatia, between the first treatise on tides published in 1528 and the research and educational activities performed before World War II, is reviewed. Among several authors who wrote about tides in the 16th and 17th century, Nikola Sagroevic should be mentioned as a careful observer. In the 18th century, Rudjer Boskovic worked on the equilibrium theory of tides, thus being the first Croatian contributor to what is today called dynamical oceanography.

From the 19th century onward, investigators have focused on dynamics of the Adriatic Sea. Grgur Bucic (1861, 1866) studied response of the middle Adriatic sea level to air-pressure and wind forcing. Artur Gavazzi (1914-1918) and Ante Ercegovic (1934-1940) investigated thermohaline structure and current fields of the Adriatic coastal waters. Finally, Josip Goldberg (1937) developed a variant of the residue method and, in cooperation with Karlo Kempni (1937, 1938), performed an empirical and numerical analysis of the coastal seiches in the North Adriatic.

Physical oceanographic topics have been taught in Croatia at the high-school level, particularly at nautical schools, since the middle of the 19th century. The first college courses were offered at the University of Zagreb in 1897.

Concurrent 8A

Oceanography in Antarctic Waters  
Tuesday, 13, July  
3:45 pm - 5:30 pm

Chair: R. Hessler, USA

***Oceanographic Research of the First Russian Antarctic Expedition,  
1819-1821***

Alexander S. Studenetsky,  
Hydrographic Service of the Black-Sea Navy

The expedition headed by F.F. Bellinsgauzen and M.P. Lazarev had the main purpose to study the unknown region of the Southern Polar Ocean. The goal of oceanographic researches, planned beforehand, was to observe seacurrents, to estimate seawater temperature and salinity and to study ices. The currents had been studied by the method based on observations of the ship drift. During the expedition a batometer with valves on its both sides had been created for taking water samples.

Bellinsgauzen was the first to investigate Antarctic ices and classify them to three groups after their origin and forming: sea ices; icebergs of mountains; continental ice sheets.

Bellinsgauzen's summary chart made up on board the sloop "Vostok" was covered with numerous inscriptions presented various observations on the nature conducted regularly during the expedition and had information concerning 173 complex oceanographic, meteorologic and others observations in Antarctic zone.

***Some Aspects of Early 20th Century Oceanography:***

***The First German Antarctic Expedition***

Maurice M. Raraty, University of Kent

The expedition under command of Erich von Drygalski was one of four sent out by different countries early this century. German experience of Antarctica was negligible, though oceanographic knowledge had been gained by the Valdivia deep-sea expedition of 1898/99. The Gauss was purposely built for Drygalski's expedition, but it revealed deficiencies in speed and design, and the scientific party was initially insufficiently rehearsed in the techniques for sounding and for taking bottom samples.

Much work was nevertheless done on the voyage to and from Antarctica, in both Atlantic and Indian Oceans, in plotting the location of parts of the Mid-Atlantic Ridge, the Walvis Ridge and the Romanche Gap, the Crozet-Kerguelen Trench and the Kerguelen-Garssberg Ridge.

Temperature sampling data led subsequently to the establishment of the existence of the Antarctic Convergence and other information was obtained to solve questions relating to currents and tides around Africa and in the circumpolar region. Experiments were undertaken on the electrical conductivity and salinity of seawater, and nocturnal trawls revealed a number of

little-known bathypelagic species. Ingenuity was also shown in the employment of local labour (penguins) for assisting with dredging under ice. The expedition proved at least equally as valuable for its work in the ocean as in Antarctica itself.

**Early Exploratory Voyages and Antarctic Expeditions:  
The Local Perspective**

Ramiro P. Sanchez; V. Angelescu, INIDEP and CONICET

During the 19th and first decades of the 20th century, several oceanographic vessels explored the continental shelf off Argentina. Its particular geographic situation, made it a necessary passage in the navigation routes of the classic circumnavigation voyages, and polar expeditions. During the period analyzed the country was undergoing a process of internal unification and transition from the austerity of colonial times, to the increasing prosperity gained from exports of cattle and grain. The aim of this paper is not only to review the contribution of those early exploratory voyages and expeditions to the development of marine science in the South West Atlantic Argentina, but also to peruse their chronicles and reports to discover different aspects of local reality as seen from the viewpoint of European scientists.

Probably no other exploratory voyage did more to draw local attention toward marine research, than the Swedish South Pole Expedition. The rescue of members of Nordenskjöld's team, - which included the first Argentine scientific observer - after the wreck of the Antarctic, may be considered as the starting point of local scientific activities in the Southern Seas. As a result of the flourishing economy and a growing interest of local authorities in the development of education and science, scientists from several European countries, among them Spegazzini who had participated in the Italian Antarctic Expedition, came to Argentina to organize and increase the collections of the Natural History Museums. The pioneer work of these prominent scientists and their Argentine disciplines is discussed. Initial local steps to teach marine biology at University level are reviewed. Descriptions and illustrations are presented of early attempts to create marine biological stations in Argentina.

Concurrent 8B

White Sea to Black Sea

Tuesday, 13 July

3:45 pm - 5:30 pm

Chair: Keith Benson, USA

***Underwater Landscape Mapping of the Seashores***  
 Alex N. Petrov, Ukraine

The study of seascapes as natural complexes forming hydrobiont communities habitat dates back in the past though main results were obtained only in the recent two or three decades. The necessity in working out a landscape-base (complex) approach happened to be most fitting in those oceanographical researches interrelations between phenomena and processes responsible for structure and functioning of marine ecosystems.

It was in 1877 that K. Hoblus who studied interactions between biotic and abiotic factors in an oyster bank introduced the term "biocenosis" to denote an integrated natural system on seabeds. Thus, it may be said that underwater landscape science began with biocenologic studies of shallow sea shoals.

An important contribution to bringing together biocenology and morphology of underwater landscapes was made by S. A. Zernov (1913). He introduced the term "facies" for the smallest sites of sea bottom homogeneous in natural conditions and settled by characteristic communities of hydeobionta. Through a large number of marine geographers (Berg, 1918, 1925, 1945; Panov, 1950; Lsachenko, 1953, 1955; Guryanova, 1959; Lindberg, 1959) declared the necessity of studying underwater natural complexes, analytic approach prevailed in oceanology until the late 1950s. That approach lacked profound study of links between ecosystem components. Some scientists rejected the very idea of landscape-geographic zonation of seabed (Ivanov 1948; Zabelin, 1958). As long as no methodology for underwater landscape studies was available, the notions and concepts of terrestrial landscape science were applied to marine systems. And this cannot be considered valid because principle landscape-forming factors are different.

***The White Sea Oceanography and Role of the Cloisters in Marine Studies and Fisheries***

H.P. Makarenkova, Russian Academy of Sciences

The White sea is situated to the South-earth of Cola peninsula and includes numerous gulfs with the bays and islands. This sea belong to arctic regions of Russia and had a severs climate. Shallow neck of the sea which is connected with Barentsevo Sea hamper the moving of warm Atlantic stream water to the White Sea. Thus the oceanography of the White Sea depend on its environmental conditions. The deep part of the sea had a temperature  $-1.4^{\circ}\text{C}$  and salinity is about 30‰. The superficial layer is warmed up to  $15^{\circ}\text{C}$  in summer but it is strong cooled down and freezes over in winter.

A systematic study of oceanography began in first 20-30 years of the 20th century. Before that the cloisters were the



first to investigate the White Sea and marine animals. Solovetsky and Seysky archipelago is situated near the Onega Gulf and consists of 6 islands. The largest island is approximately 219 square kilometers. The Solovetsky cloister was founded in 1536. It was the only Russian cloister that had its own army and Solovetsky cloister was transformed into a sea fort during every war. In the middle of the 16th century Philip became a head of the cloister. He had built a very complicated hidrotechnical system of channels, developed fisheries and marine studies. Several White Sea expeditions were organized at that time. For a long time fishery was the main source of food and income for Solovetsky cloister. There are two species of herring in the White Sea: Atlantic herring - *Clupea harengus* and pacific - *Clupea pallasii marisalli*. Since the 16th century the observations of herring populations gave a reason to control fisheries in one and the same place. It saved herring populations up to now. Our last studies revealed that these populations from different gulfs differ from each other by a frequency of chromosomal rearrange and may be characterized as reproductively isolated.

The Solovetskaya Biological Station founded in 1882, was based to study benthos animals. Since this year, the station which was of importance for many famous Russian scientists: Ber, Derugin, Polansky and others, had taken up their work in the islands. The life cycles of marine animals had been studied.

Seysky cloister was founded by Antiniy at the river Seya near Onega gulf and play an important role in studies of fish and marine animal migrations.

In our time three new marine biological stations have been founded at the White Sea.

***Some Historical Aspects of Development of the Researches in the Institute of Biology of the Southern Seas, Made by A. Kovalevsky (IBSS)***

S.M. Ignatjev; A.N. Petrov, Ukraine

Hydrobiological research had an episodic character before the organizing of the system of the scientific stations on the opinion about poorness of life in the Black Sea. The history of the oldest marine biological station in Sevastopol (1871) has some different periods, connected with both change of directions of scientific research and re-organization of its structure. It must be taken in to account, that Sevastopol Biological Station (SBS, from 1963 - IBSS) had to stop its work twice during its history (1914-1922 and 1941-1945).

1. 1871-1902. Descriptive-fauna period, when the main direction of the SBS activity was study of the Black Sea fauna and making of the lists of animals living in it. 880 species of different hydrobionts were in the lists by the time V. Sovinsky's report publication (1902). It was a difficult period of the

station formation, because it was supported only by scientific societies and private donations. In 1892 SBS was admitted under the jurisdiction of the Imperial academy of Sciences with financing of its scientific activity from the state treasury. It was favored by the results of the Black Sea expeditions (1891-1892), which considerably enriched knowledge of hydrobiological and physical-chemical processes in the Black Sea.

2. 1902-1914. The new "ecological" stage of SBS works. It is connected with academician S. Zernov's name. During this period detailed study of bottom hydrobionts distribution and exposure of the main interconnections with the environmental factors were carried out. The stable financial support of the Academy of Sciences has turned the Station into the center of marine research in the south of Russia.

3. 1922-1941. During the first world war and the Civil War (1914-1922) SBS didn't function, but its property and scientific materials were managed to keep. It was later allowed to continue the hydrobiological works in the coastal regions of the sea. During this period the works were begun in new directions: Study of plankton of open water areas and resources of producers objects of the USSR territory waters. It was connected with SBS participation in the long-term large expeditions: Azov-and-Black Sea scientific-producers' expedition 1922-1928 and the Black Sea oceanographic expedition 1923-1935. When the research vessel "Alexander Kovalevsky" was bought in 1929, the scientists of the station began to carry out the independent research on hydrochemistry, marine microbiology and hydrobionts physiology.

4. 1945-1959. During the second world war SBS was completely ruined: the library, archives, collections, vessels were lost. SBS was restored only due to the efforts of the Station director V. Vodyanitsky. He also started the Black Sea biological productivity study, that became the main direction of SBS research. Together with traditional directions new ones were developed at the Station - sea sanitary hydrobiology, radiational and chemical hydrobiology, functional morphology of hydrobionts movement. It's led to quantitative increase of the Station staff. In 1958 the new vessel was got. Traditionally it was given the name of academician A. Kovalevsky. It favored the expansion of the scales and geography of the expeditionary research.

5. 1959-1976. SBS scientific potential development had to lead to its status rise up to level of marine institute. It happened at the same time when the Station was given by the Academy of Sciences of the USSR under the jurisdiction of the Academy of Science of the Ukraine (1963). Then on the base of three marine stations (Sevastopol, Karadag, Odessa) the Institute of Biology of the Southern Seas (IBSS) was organized having the center in Sevastopol. This re-organization had led to transfer of the traditional works on fauna, ecology and bioproductivity to the seas the "Mediterranean" type: the Mediterranean Sea (from 1959), the Red Sea (1961-1964), the Caribbean Sea (1964-1966).

6. 1976-1991. The complex research of the IBSS in the World Ocean are increasing (tropical and equatorial waters). Special attention is paid to study of potentially productive regions (dynamically active zones, underwater raising). At the same time ecological investigations in the seas of the Mediterranean basins are continued. The works, connected with radiation situation monitoring, analysis of responses of pelagic and bottom ecosystems to pollution and increasing of eutrophication of water areas, working out of theory and practice of aquaculture have broad development. However, recent disintegration of the USSR and development of economic crisis don't allow the IBSS to broaden these perspective research.

### Plenary 6

Scripps at Ninety  
Wednesday, 14 July  
9:00 am - 11:30 am

Chair: George Shor and Betty Shor, USA

***Scripps Benefactions: The Role of the Scripps Family in the  
Founding of the Scripps Institution of Oceanography***  
Deborah Day, Scripps Institution of Oceanography

The Scripps Institute of Oceanography was founded in 1903, when University of California Professor William E. Ritter interested newspaper publisher E.W. Scripps and his sister Ellen Browning Scripps in the idea of founding a marine biological station on the coast of California. The Scripps Family provided almost all the funds to establish the station during its first decade. When the institution became part of the University of California, the state of California matched Scripps Family contributions to the institution for many years. This paper explores the relationship between the Scripps Family and the station named for the family and chronicled both their financial and intellectual contributions to the institution.

***C.A. Kofold's Role in the Origin of Scripps Institution of  
Oceanography***

Fred Noel Spiess, Scripps institution of Oceanography

A major milestone in the history of Scripps was the construction of its first permanent building, the George H. Scripps Memorial Marine Laboratory, in 1910. A key figure in the design and equipping of this establishment was Dr. Charles Atwood Kofold, a long time associate of Director William Ritter.

Kofold's interest in plankton and in aquatic biological stations, developed during his early years at the University of

Illinois, as well as good contracts abroad, and six years as Assistant Director of Ritter's embryo marine laboratory, prepared him well for travel to locate equipment and to study the characteristics of the numerous European Marine Laboratories.

His 1909 tour, extending from Italy to Finland and from Ireland to Russia, not only provided perspective for design of the Scripps Building, but netted extensive high grade equipment from Norway and the well known book on The Biological Stations of Europe.

Upon his return he continued as Assistant Director, while at the same time taking on the Chairmanship of the Department of Zoology at Berkeley, holding that post for over twenty years. When Ritter relinquished the directorship in 1923, Kofold also withdrew, terminating his association with the biological station twenty years after its founding.

#### ***Recollections of People and Activities At Scripps During the 1930'S***

Eugene C. LaFond; Katherine G. LaFond, LaFond Oceanic Consultants

In the early 1930's Scripps, with a new laboratory building, several new staff members and a sea-going vessel, was emerging from a biological laboratory into a true oceanographic institution. Katherine's chance meeting with Dr. Erik Moberg in May 1933 led to her employment as a chemist to analyze the samples for sea water recently received from Costa Rica. Soon she was doing not only all the sea water analyses but also assisting Dr. Moberg in a research program to determine the boron/chloride ration of sea water. Dr Moberg was also working on the buffer mechanism of sea water.

Gene arrived in September 1933 and was offered a volunteer position with T. Wayland Vaughan, the director, who had acquired a copy of the serial station data from the ill-fated R.V. Carnegie and, at the suggestion of Dr. Harald Sverdrup, wanted T-S diagrams constructed. This work led to assistance with figures for Dr. Vaughan's book on the International Aspects of Oceanography. In addition, Gene became involved with Dr. George McEwen's program for long range weather forecasting, Dr. Francis Shepard's work on near shore processes and Dr. Moberg's infrequent cruises along the coast and channel islands. With the arrival of Dr. Sverdrup, new studies were instituted and with the addition of a new ship, the sea observation program was completed.

Living on the campus was convenient and inexpensive. We were a small, cohesive happy community, creating our own social activities such as tennis, potluck suppers and grunion hunts. Mrs. Vaughan's teas added a note of culture.

#### ***Sverdrup Years***

Walter H. Munk, Scripps Institution of Oceanography

Sverdrup was director of Scripps from 1936 to 1948. I first met him in 1939 when I came down from California Institute of Technology as a summer student. In 194- he was working on the book: "The Oceans" with co-authors Johnson and Fleming. I will discuss my experience serving as a live audience to Sverdrup while he was composing the famous chapter XV: The Water Masses and Currents of the Oceans. The book was published in 1943, exactly 50 years ago, and has had a profound influence on the development of Oceanography.

At the outbreak of the war, Sverdrup was engaged at the University of California Division of War Research dealing with problems of underwater sound. We worked together on developing a method for predicting wave conditions for amphibious landings, and organized a course on wave prediction for weather officers in the Navy and Air Force. The method was used in the Pacific and European theaters of war.

*The Innocents Abroad Early: Scripps Institution of Oceanography's 1950's Exploration of the Pacific*

Robert L. Fisher, Scripps Institution of Oceanography

From June 1950 when R/V Horizon joined the SIO-US Navy Electronic Laboratory's expedition MIDPAC to explore the Mid-Pacific Mountains until Argo's mid-1961 return from Scripps' initial venture into the Indian ocean, five La Jolla-based ships individually and jointly explored more than 948,000 nautical miles of seafloor and the overlying water mass. Spencer F. Baird, Horizon, Stranger, Argo and Hugh M. Smith, variously equipped, employed then-state-of-the-art, now quaintly primitive if ingenious, methods and modified WWII devices to explore, with oceanographers really, essentially the entire Pacific. With very young, adventurous, ex-Navy chief scientists, staunchly supported by an institution that knew and cared for the sea, Horizon and Spencer F. Baird - in distant company, perhaps competition, with L-DGO's Vema and the Soviets' Vityaz - by 1960 had made meshed deep seafloor geological-geophysical observations - in survey bathymetry, seismic refraction, magnetics and heat flow - of deep Pacific trenches, the East Pacific Rise and incredible Northeast Pacific fracture zones, and the volcanic seamount chains, even establishing the thinness of the oceanic crust and minor overburden. These observations, once assembled, led very soon to the integrating mechanism, seafloor spreading, of Hess in particular. Meanwhile SIO's physical oceanographers and biologists, with agency shipmates, made equal advances, discovering and exploring the Equatorial ("Cromwell") Undercurrent and retrieving new species marking it and the midwater realm.

# **Concurrent 9A**

## **Pacific Marine Biogeography in Historical Perspective**

Wednesday, 14 July

1:30 pm - 3:15 pm

Chair: E. Alison Kay, USA

### ***Ocean Current Patterns and Dispersal of Coral Reef Fauna: Changing Historical Perspectives***

Paul L. Jokiel, University of Hawaii and Hawaii Institute of  
Marine Biology

Historical development of information on dispersal routes, dispersal range and dispersal mechanisms has led to greater understanding of processes controlling contemporary biogeographic distributions. Westerners gradually developed an understanding of world-wide oceanic current patterns and drift rates in the 16th through 19th centuries, along with an increasing knowledge of biogeographic distributions of coral reef species. Long-range dispersal of organisms by rafting was discussed frequently in the early literature. However, the idea that long-range dispersal of inshore marine organisms is exclusively accomplished by planktonic larvae began to dominate scientific thought in the early 20th century. Recent data on the longevity of planktonic larvae suggests that larval dispersal range for some species is extremely limited. Settlement of larvae on floating logs, pumice and other material greatly increased potential dispersal range. Therefore, interest in this mechanism had been revived and the commonplace occurrence of marine rafting has been documented. Focus on drift patterns as a primary forcing function in controlling biogeographic distributions has led to renewed interest in another old idea: centers of high diversity may represent centers of species accumulation rather than centers of species accumulation rather than centers of species origin.

### ***The Development of the Oceanography in the E.T.P. and the Understanding of Biogeographic Isolation and Evolution in the Galapagos Islands***

Guy T. Houvenaghel, Université Libre de Bruxelles

The oceanography of the Galapagos remained poorly known until recently. The importance given since Darwin's times to terrestrial species as showcases of evolution, left marine life rather marginal and hydrology mostly ignored. The superficial cold waters noticed in the area, influencing local climate and biota, has been recognized as a major feature of the biogeography of the archipelago. the local and regional oceanographic setting, where water masses and circulation are intricate, were

poorly known with the result of vulgarization and perpetuation of rumor about so called antarctic influences reaching the islands through the Humboldt or Peru currents.

Discoveries during last decades showed that the cold waters around the Galapagos are influenced and driven by the Equatorial Undercurrent. This results in severe climatological and ecological conditions affecting the islands according to appterns linked to the archipelagos is, as a result enhanced by the local cold water upwellings.

Progress in understanding why the Galapagos environment provided the remarkable examples of species isolation, endemism and evolution already shown by Darwin were comparatively recent, resulting from the progress in the oceanography at E.T.P. and local levels.

***James Dwight Dana's Principle of Cephalization***  
Janet Bell Garber

James Dwight Dana (1813-1895), one of the foremost scientists in nineteenth century United States, in his report on Crustacea collected during the American Exploring Expedition, 1838-1842, compared the Crustacea in the waters of the Pacific to the Human populations of the adjacent continents and islands. According to Dana, the highest quality of Humans lived in Antipodes of England and New Zealand. Similarly, the highest quality of Crustacea, as determined by head-size or "cephalization," lived in the cold waters surrounding the two island nations. Dana observed that both coasts of North America had relatively cold waters as well, and comparatively "high-grade" Crustacea, while the warmer waters off Africa, India, and the Pacific islands supported populations of Crustacea with smaller, and thus "inferior" head-size. Dana's theory was suited to both idealism in science and to creationism in American Protestantism, and had an empirical basis in his studies of ocean temperature and comparative anatomy of Crustacea. It was attractive because it represented an attempt to reconcile science and religion, but it was criticized by other scientists when applied to the entire animal kingdom.

***H.B. Guppy: A Reef Fish Out of Water in the Late Nineteenth Century***

David R. Stoddart, University of California at Berkeley

Throughout the nineteenth century, especially in the western Pacific, considerable contributions to reef knowledge were made by 'surgeon naturalists' in the Royal Navy, including such luminaries as Huxley and Hooker. Henru Brougham Guppy (1854-1926) was one of the most capable, and entered reef studies at a critical time and in an innovative way. After work in the China

Sea (1878) he studied calcareous rocks in the Solomons in H.M.S. Dark (1881-1884). This resulted in a series of publications in the eighties at the height of the reaction against Darwin's views following the latter's death in 1882 and the return of John Murray from the Challenger Expeditions. Guppy had the misfortune to stumble into the controversy generated by the Duke of Argyll in 1887-1888, and had the retrospectively dubious advantage of falling under the aegis of Murray. This led him into difficulties with the Geological Society of London in consequence of tension between scientific London and Edinburgh. Murray then sent him to study the Christmas Island phosphates, but to Guppy's chagrin a rival entrepreneur put him ashore instead at Cocos-Keeling Atoll. Here he made detailed studies of reef structures, including the first reef budget studies. Thereafter he worked extensively in Fiji and the West Indies, but more on the strand floors than on reefs. This paper analyses his contribution to the coral reef debate of the last two decades of the nineteenth century, and asks why a man of such immense field experience made so little impact in the scientific establishment of the day.

#### Concurrent 9B

##### Ancient and Native Ocean Traditions

Wednesday, 14 July

1:30 pm - 3:15 pm

Chair: Donald McGraw, USA

##### *Caroline Islands Native Knowledge of Marine Animals and the Ocean* Alan Eugene Davis, Faichuk Jr. High School

Traditional Caroline Islands knowledge of marine animals is surveyed. Potential theoretical interests are reviewed and exemplary thread presented. Time reckoning knowledge includes a sophisticated sidereal almanac; calendrical systems integrate diverse terrestrial and marine events; a system may still exist linking flowering/fruitlet of plants with marine cycles. A myth of the Pleiades is presented, of obvious time reckoning value. Appearance of an eel, possibly Myrichthys colubrinus, at the onset of breadfruit season is interpreted either as a sign of a good harvest or as an omen of death; specificity of timing suggests reproductive periodicity. Appearance of the nudibranch Hexabranchus sanguineus is said to portend calm weather and might also be a seasonal marker; other weather signs are known. Birds are used in land finding and fishing; several sea birds are domesticated, possibly as a research program for study of bird behavior. Also reviewed are marine resource management practices, protoaquaculture, sea marks used in navigation, and knowledge of fish periodicity. A concept similar to our 'niche'



suggests reduction of empirical observations to a principle. Some practical advice is offered from the seafarers' survival kit concerning comportment when overboard at sea, including protection from sharks.

***An Account of Traditional Oceanographic Knowledge Prevailing  
Among the Tribes of Andaman and Nicobar Islands***

G.A. Thivakaran; G. Victor Rajamanickam, Tamil University

The Andaman and Nicobar Islands are the homeland of the most primitive tribes of Negreto stock like Jarawas, Sentinelese, Onges, Great Andamanese and Mangoloid stock of Nicobarese and Shompens. Their total segregation from the rest of the world for hundreds of years, brought them for a great dependency on sea for food. Nevertheless a dire need to go to other Islands to get some materials had given a strong impetus to evolve an indigenous oceanographic knowledge and navigational techniques which still exist in a pristine state. This paper outlines some of the basic aspects of their abstract oceanographic knowledge.

Seafaring is seen active only during particular seasons like 'Mukyop' (December - January), 'Ranecaba' (January - February) and 'Tutch' (February - March) and strictly prohibited during 'Amu' (April - May). Waves are differently categorized by different tribes. During long voyages one particular type of wave called 'Nayange' is greatly helpful to find out the direction. The tidal cycle is related to the waning and waxing of the moon. Long journeys to far-off islands are invariably launched during lowtides only. Similarly, currents are classified into 4 major types, i.e., Haem kudi (from the north), Haem kulan (from the south), Haem kuli (from the east), and Haem kuvath (from the west). The direction of these currents are believed to be influenced by the lunar phase. Their knowledge of different winds, their season and direction is immense. Generally, four principle winds like 'Chu' (west wind), 'Kaba' (north wind), 'Susam' (east wind), 'Lohaha' (south wind) are recognized which prevail in definite seasons. The east wind (Susam) which blows during the season of 'Tutch' is considered favorable for navigation. Depth is crudely adjudged by the sound of friction produced at the hull and water surface and from the interpretation of the water color. Direction and position are mainly delineated by shore features and by observations of different Islets and stellar bodies like stars, suns and moon. Foulweather or cyclone is predicted by collectively considering clouds, winds, waves and marine and terrestrial life. However, all these traditional skills are gradually becoming extinct by their increased contact with outsiders.

***From Satan to Shamu: The Making of the Killer Whale***  
Brian Mackness, The University of Melbourne

This paper traces representations of the killer whale through time, using myths and icons from traditional cultures, the writings of early natural historians as well as a multiplicity of recent visual and written forms. It examines the conflicting values inherent in popularist images of the orca and also looks at the changing nexus between science and popular writing, particular how this had altered perceptions of these animals. The anthropomorphic interpretation of captive orcas and their exhibition in theme park environments is reviewed as a potential agent in the rehabilitation of the human/orca relationship.

***Brief History of marine Development in Ancient China***  
 Xu Qiwan, State Oceanic Administration of China

China has a coastline of about 3200 km in length, over 18000 km for the mainland and over 14000 km for the islands, and is an important coastal nation in the Pacific region. China has made great contributions to the human civilization in the history.

The history of the utilization of marine resources by the Chinese may be as long as 18000 years. The ancient Chinese got the knowledge of how to fish on the sea shore 18000 years ago. This was the beginning of the of taking marine animals as food, and also the beginning of basic production activities.

As early as before 2200 years B.C., the ancient Chinese knew how to extract salts from seawater and the salt taxes were one of the financial sources for each feudal dynasty.

The Chinese sea transportation industry has also a long history, and it is dated from the Stone Age. It had made a great achievements by the Ming Dynasty (in the 15th century).

The history of the Chinese coastal engineering can be traced back to the period of East Han Dynasty (about 25 - 220 A.D.). A lot of the coastal defence project had been built.

The article gives a brief description of the history of four marine industries and sums up some experiences from which much can be learned.

***The Voyages of Zheng He Before Columbus***  
 Ye Longfeng; Song Zhenghai; Walter Lenz,  
 South China Sea Institute of Oceanology

In early Ming dynasty, in the period 1405-1433, for seven times Admiral Zheng He voyaged from China to East Africa across the Indian Ocean through the South China Sea and the Strait of Malacca. His fleet consisted of more than 50 large warships (each about 1200 ton) with more than 25 thousand soldiers on board. These voyages were much larger on scale and earlier than those of Columbus and other western voyagers. However, confined

to the Chinese traditional ideology, these did not lead to the geographical discovery in world history.

# Concurrent 10A

## **Ecology: Littoral and Abyss**

Wednesday, 14 July

3:45 pm - 5:30 pm

Chair: Fritz Rehbock, USA

## ***The Rise and Fall of the Community Paradigm***

Joel W. Hedgpeth, Oregon State University

The first community paradigm (in the Kuhnian sense) was the statement by Karl Mobius of the oyster reef as a biocoenosis, with an overt implication of homeosis that in the modern sense has a strong flavor of Gaia to it. Many subsequent studies, especially by C.G.J. Petersen and followers, attempted crude quantitative studies of bottom communities with incomplete knowledge of changes through time and the life cycles of the species involved. It remained for Ralph G. Johnson, a paleontologist seeking ways to understand the incomplete fossil record, to carry out some of the critical long term studies needed in a region where late Pleistocene (or early Recent) assemblages including species related to those present today, occurred in the same locality, Tomales Bay, a fault rift bay just north of San Francisco. These studies, carried out for several years with teams of graduate students and high school teachers, with the data critically analyzed by modern statistical methods, laid the homeostatic biocoenosis to rest.

## ***On the Nature of Final Proof in Biology: Hadal Bacteria and the "Azoic Zone"***

Donald J. McGraw, University of California at San Diego

Since at least the mid - 1800's, when Edward Forbes spoke of an "azoic zone," a depth below which no life was believed to exist in the sea, marine scientists have plumbed ever greater depths in search of abyssal life. With each successive expedition, the upper limits of the azoic zone were pushed ever deeper. It was not until July 15, 1951, that Claude Zobell determined finally that the very concept of such a zone was invalid when, aboard the Galathea, he demonstrated viable bacteria in the Philippine Trench. This paper examines this history and considers the nature of what constitutes final proof in biology.

***Deep-Sea Plankton Exploration in historical Perspective***  
 Baruch Kimor, Israel Institution of Technology

Man's understanding of the mystery of life in the oceans' depths is closely related to the history of oceanographic research. As late as the mid-1800s the view still prevailed that life in the open sea was limited to the upper 100m, where light-dependent phytoplankton provided the primary organic matter necessary for sustaining animal communities. Later in the nineteenth century, studies probing the deep basins of the world oceans, provided evidence of living organisms well below the euphotic zone. Findings of the Challenger Expedition (1870-1873), as well as somewhat later cruises, e.g. Valdivia and Michael Sars Expeditions, showed a wide spectrum of free-floating animals existing right down to the sea bottom. Interdependence of trophic levels in deep-sea food chains is still not entirely understood. In this century, an increasing number of reports by scientists working in the Pacific, Atlantic and the Indian Oceans, including accounts from the Mediterranean, have described apparently viable algal cells deep within the euphotic zone. Their adaptation and functioning there remains unclear. Yet, they constitute packets of organic matter which, together with other materials sedimenting from the euphotic zone, can provide food for zooplankton. Such findings contribute to the development of a scientific explanation for the functioning of deep-sea ecosystems.

***Molecular Biotechnology and Oceanography -- Diamonds in the Rough***  
 George I. Matsumoto, Stanford University and Monterey Bay  
 Aquarium Research Institute

Almost a century ago, Haeckel was among the first oceanographers to recognize that both the ocean and the biota within are heterogeneous in structure and composition. It has not been until the last twenty years that advances in molecular biotechnology have enabled us to support that statement. The determination and study of marine populations have benefited greatly from the application of molecular techniques (e.g., allozyme and nucleic acid analyses). The ability to amplify specific sequences of DNA has been made possible by the development of the Polymerase Chain Reaction. This technique was developed in 1986 and has completely transformed the manner in which we approach biological questions. This paper reviews some of the methodology involved and presents a brief synopsis of some of the questions that have been and will be addressed using the tools of the molecular biologist.

**Oceanography South of the Sahara**  
 Wednesday, 14 July  
 3:45 pm - 5:30 pm

Chair: Anwar Abdul Aleem, Egypt

***Trends in Ocean-Climate Services in West and Central Africa***  
 S.O. Ojo, University of Lagos

This paper discusses the past and present oceanographic programs and services in West and Central Africa with a view to assessing their status and their accomplishments in relation to ocean-climate systems. The paper then discusses the future developments, bearing in mind the urgent need to consider the user community in any future developments and possibilities. Three phases of development are recognized for the purpose of reviewing and discussing the past and present trends in oceanographic services in colonial and the post-colonial phases. This paper also examines the topic with particular reference to the involvement of:

- (a) Governments or Government institutions set up to perform oceanographic services in the region.
- (b) Academic or research institutions of higher learning and
- (c) International bodies and institutions whose oceanographic activities directly or indirectly affect ocean-climate systems and services in the region, and especially those activities which involve linkages with the Pacific region.

The paper finally discusses the problems and opportunities for improving the status of oceanography and oceanographic services in relation to ocean-climate systems, and emphasizes the need for a change in the current emphasis on "immediate" economic gains. The paper also emphasizes the need for interdisciplinary cooperative activities and co-ordination of activities related to oceanography in general and ocean-climate services in particular. Other issues discussed include those related to:

- (a) Data availability, inventory and archiving
- (b) The need for research
- (c) The need for transfer, adaptation and use of technology
- (d) Education and training and
- (e) Financial involvement of program and services related to ocean-climate activities.

***Oceanographic Expedition Records of the West Indian Ocean up to 1965***

Norbert A. Kayombo, Humboldt University

During the 19th and 20th century a number of oceanographic expeditions traversed the West Indian Ocean, results of which

contributed to the understanding of marine knowledge of the region.

The German deep sea expedition with the steam ship 'Valdivia' (1898-1899) explored parts of the West Indian Ocean waters. The research ship made contributions to the understanding of oceanographic aspects of the region with respect to physical chemical and biological oceanography. Two other German ships 'Gauss' (1901-1903) and 'Planet' (1906-1907) explored parts of the south west Indian ocean. The John Murray/Mahabiss expedition (1933-34) mounted by the British aboard an Egyptian vessel 'Mabahiss' brought light to the understanding of upwelling off the Arabian and East African coasts. Some parts of the North Indian Ocean were surveyed in the early fifties by the Challenger's expedition (1950-53). The multinational International Indian Ocean Expedition (1959-65) gave a tremendous boost to the understanding of oceanography of the West Indian ocean region. Information obtained by various research ships contributed to the production of oceanic atlases of the International Indian Ocean Expedition.

**NOTICE:**

**MANUSCRIPTS:** Conference Organizers will solicit completed manuscripts from papers presented at the Fifth International Congress on the History of Oceanography after the conference, for possible inclusion in the published proceedings. Contact Dr. Keith Benson, Department of Medical History and Ethics, SB-20, University of Washington, Seattle, WA 98195 USA for details.

### *Alphabetical Index by Author*

Ahlstrand, 6	Knauss, 39
Aleen, 23	Krishnamurthy, 13
Alekseev, 4	LaFond, E, 52
Allwardt, 40	LaFond, K, 52
Alvarez-Borrego, 5	Le Grand, 41
Angelescu, 47	Lenz, 33
Antezana, 1	Lyons, 26
Appel, 38	Mackness, 57
Atwater, 41	Marinescu, 44
Badash, 36	Makarenkova, 48
Bahamonde, 1	Markham, 7
Benson, 13, 37	Marsden, 34
Bologa, 44	Mather, 28
Charnock, 21	Matsuda, 4
Coffey, 15	Matsumoto, 60
Daniel, 2	McEwan, 3
Davis, 56	McGraw, 59
Day, 6, 51	McTaggart, 43
Deacon, 26	Menanteau, 11
Della Croce, 32	Mikulski, 8
Dickson, 42	Mills, 17
Dyrssen, 21	Morcos, 11
Fisher, 53	Moritz, 6
Fontaine, 34	Munk, 53
Friedman, 1	Neushul, 36
Garber, 55	Nierenberg, 20
Grandperrin, 2	Normark, 20
Groeben, 5	Ojo, 61
Hedgpeth, 59	Omori, 30
Henson, 7	Oreskes, 40
Henin, 2	Orlic, 45
Hisard, 15	Parsons, 35
Houvenaghel, 54	Peterson, 17
Hubbard, 35	Petrov, 48, 49
Ignatjev, 49	Rajamanickam, 57
Ingmanson, 25	Raraty, 46
Irvine, 38	Reid, 18
Jokiel, 54	Robison, 10
Jones, I, 16	Rougerie, 2
Jones, J, 16	Saldanha, 22
Kawaguti, 28	Salvat, 28
Kayombo, 61	Sanchez, 47
Kimor, 60	Savours Shirley, 19
Kinzie, 29	Scheiber, 31
Kortum, 33	Schwartzlose, 5



Serpoianu, 44  
Shor, 9  
Sivkova, 19  
Smed, 43  
Spencer, 24  
Spiess, 51  
Srivastava, 14  
Stoddart, 27, 55  
Studenetsky, 46  
Svansson, 10  
Thivakaran, 57  
Tirmizi, 14  
Toro, 31  
Tracey, 28  
Tregubov, 8  
Vasile, 24  
Walker, 12  
Weir, 37  
Wilson, 20  
Wolff, 25  
Wood, 3  
Wu, 3  
Wyrcki, 18  
Xu, 58  
Yayanos, 22  
Ye, 58